ENGINEERING NEWS.

THE Vermont Railroad Commission's finding as to the Woodstock disaster has been made public this week, sustaining the view we took of the cause of the disaster, that it resulted exclusively from a broken rail, as sufficiently clear from the first. The Commission goes out of its way, however, to add (if the published abstract is correct) the following rather gratuitous bit of white-washing:—

"There was no guard rail on the bridge, but as the Commission find the accident was not contributed to by that fact, *they do not express any opinion about this particular bridge*, but suggest that railroad companies should take every precaution on approaches to bridges as well as over bridges. There was a proper slowing up of the train, and there was no culpable negligence on the part of the railroad company."

If there were no guard rails of any kind on the bridge, that was certainly culpable negligence. Our information is that there were; as respects the protection of the ends of bridges which we illustrated in our issue of Feb. 12, and which is beyond question what the Commission alludes to in its finding, it is true in a sense that the company was not culpably negligent in not having it or some equivalent, because a large majority of other roads do not have it. But that road or any other will be unpleasantly open to the charge of negligence if some succeeding disaster finds them unprovided with it, and the Commission might well have said so less generally, for we think it was conclusively shown in the same issue of this journal that the chances were many to one that all the horrible consequences of the derailment would have been saved, had the device which we illustrated been in use—or possibly even the less perfect device which a correspondent sends us this week—and all at an expense of only $100 to $125 per bridge. It is not unreasonable that so much expenditure should be demanded to secure safety.

SOME engineer probably feels relieved or ought to, over the miraculous escape from a terrible wreck of the train under which a 60-ft. iron bridge fell last week, on the Cleveland & Pittsburg Railroad, because of a defective bridge foundation. All the conditions were present for a disaster as fatal as, and more discreditable than Ashtabula, except high speed, and a very heavy train. No one was even injured badly, but the accident was one of the most notable ones of the week. Fire broke out instantly, which as no one was hurt could be put out.

WE notice, by the Wilmington, Del., press, that Col. GEO. E. WARING, Jr. is meeting with some opposition in his proposal to introduce into that city the well known Waring system of separate sewerage. There are apparently no less than four Wilmington associations which are willing and anxious to serve their fellow-citizens—and pocket the profits thereof—on much easier terms than are offered by Col. WARING. These associations are now seeking the requisite authority from the Delaware Legislature; and, as near as we can make it out, propose to put in a drainage system at their own expense, and depend upon the voluntary patronage of the abutting householders; and to further pay into the city treasury 50 cts. per front-foot for each property drained as compensation for connecting with existing city sewers. The radical difference between their proposed system and the one objected to is, that by their plan the householder only pays if he connects with the sewer; while on the Waring plan, he pays for its construction whether he wants to use it or not. If the new sewers are properly designed and constructed, the citizens will doubtless soon use them in either case. But we think that the voluntary plan has merits that would be rather forcibly expressed if the public had an opportunity to speak upon the subject.

THE oppressive and arbitrary methods of the Knights of Labor have come to grief, or are coming to grief in several directions, which is well. Experience keeps a particularly dear school for instruction on the labor question, but both employers and employed will learn in no other, and we should remember that both have need to learn. The worst folly and unreason lately has been on the side of the men, and in the nature of things must always tend to be, but in doing away with the outrageously long hours which street car employés formerly had to submit to, that organization did a real good which should alone cover a multitude of sins, and has need to. The permanent security against any real harm from the fermenting process which is now going on lies in the good sense and the law-abiding and reasonable disposition, which is common to all large classes in this country, when they once see what reason is.

THE heading of shafts 19½ and 20 New Croton Aqueduct met on the night of Feb. 1. The distance between the two shafts is 3,200 ft.

From engineers' progress reports we notice that the shaft 20 people finished their part of the job with a remarkably fast bit of tunnel driving. From Jan. 15 to Feb. 1, the day of the juncture, 189 ft. of heading were driven in the north end of 20.

The heading was a large one (in the "Horse Shoe" section) 8x21 ft. and was closely timbered with three block sets. The ground passed through was a rotten sand rock. Two Rand Slugger drills were used.

The work was done by COLLINS & FARWELL under the immediate supervision of Mr. HENRY COLLINS, assisted by Mr. A. M. NEVIN. The heading foremen were CHAS. MARSH and R. PERINNI, both men of varied European and American tunnel experience.

The variation from true alignment was .075 ft. The levels check within .020 ft. Mr. GEORGE OLNEY is engineer in charge, with Mr. H. RATHBONE transit man on this section.

OUR two greatest corporations have this week been giving their employés and the public generally an object lesson in respect for law and order, at Erie, Pa., which may, perhaps, bear fruit in the next strike. The merits of this latest of so many crossing conflicts, we shall not attempt to discuss. "The quarrel is a very pretty quarrel as it stands. We should only spoil it by trying to explain it." But the violent methods would not have been resorted to; one cannot help suspecting, had not one of the parties felt it had little to hope, and the other perhaps little to fear from the state authorities. The results were in no way serious, but the incident is all the better illustration of the possible good which may result from a judiciously administered national railway commission.

THE President of the Dublin Sanitary Association expresses disappointment in the results obtained by improving the Liffey, which a few years ago was a reeking sewer. A high death-rate was the incentive for material change in conditions; but the returns now show 3,500 more lives lost in the last decade, than in previous decades and before the improvement. The figures seem to prove that the present Irish mortality is rather due to the lack of proper food and clothing, and to immediate household surroundings, than to the necessity for extended drainage experiments.

Mr. BENJ. BAKER, in a late lecture before the Edinburg Institute, said that there were now 3,500 men at work on the Forth bridge. The plant included 30 steam and other launches, barges, etc.; 60 steam cranes and winches; 50 hydraulic cranes; 100 hydraulic jacks; 100 hand cranes; 100 drilling machines; 48 steam engines; several hundred machine tools; 350 hydraulic riveters and rams of various kinds, and over one million cubic feet of timber in staging and temporary work. Altogether nearly $2,000,000 had been expended on plant and temporary work; $1,800,000 on steel plates and $1,750,000 in daily wages to workmen; a total of $5,550,000.

The Engineer of Feb. 4, gives the progress on the Forth bridge to that date as follows: At the South Queensferry piers, the main columns have been built up about 196 ft. above datum; the average height of the diagonal struts in place is about 192 ft., and the curved bottom members extend out 20 and 40 ft. The working platform is now 191 ft. above datum. Including tubes and girders, about 2,300 tons of material have been riveted. On the Inch Garvie pier, the horizontal tubes and bracing girders are complete; the vertical columns are 108 ft. high, and the diagonal struts 82 ft.; the curved bottom members extend out 26 and 28 ft. The total material here riveted is about 2,500 tons. At the North Queensferry pier, riveting is still in progress on the skewbacks, about two-thirds being done; the vertical columns are 236 ft. high; the diagonal struts 215 ft., and the erecting platform is 220 ft. above datum. The bottom members on the south side extend out 60 ft. from the skewbacks. The total steel work here riveted, amounts to about 2,400 tons. The girders on the nine north approach spans are 96 ft. about datum; and on the other side they stand at 135 ft. To date given, 424,000 cu. ft. of granite had been set in the piers of approach viaducts, etc., and about 102,000 cu. yds. of rubble masonry and coucrete work had been built. In all 35,000 tons of steel have been delivered.

THE total expenditure on the Vyrnwy dam and reservoir now building for the Liverpool Water supply, to date of June, 1886, was $6,911,165, allowing for the selling value of the plant at that time. The cost of the materials and work at the dam is given as follows in a late number of *The Engineer*:

	Per cu. yd.
Cost of stone at quarry	$2.88
Cost at dam, with wheeling, wages and material	3.12
Building labor, per cu. yd. masonry (about)	0.56
Stone, per cu. yd. masonry	2.20
Plant, tramway and opening quarry	0.64
Superintendence at quarry	0.13
Building, including material, but not stone	4.14
Plant, pumps and staging, 72 cts. Supt. 48 cts.	1.20

The proporition of stone to masonry varies from 66 to 62 per cent. The face stone is carefully cut and drafted, and the interior built of massive rough blocks with all interstitial space filled with smaller stone, and Portland cement mortar made of one part cement to 2½ of pulverized slate rock and sand, the latter being two of fine rock to one of sand.

THE Manchester Ship Canal is still alive, but apparently quite weak. At the late meeting of shareholders it was stated that the total receipts to Jan. 1, 1887, amounted to $702,580, and the total expenditures to $763,010. Complete surveys for land required are nearly finished. At this meeting Mr. JACOB BRIGHT, M. P. Sir J. C. LEE, the Deputy Chairman, and Mr. HOULDSWORTH, M. P., resigned, with four others of the Directors; the purpose being to reorganize the board and to again place the project before the public.

"Carrying coals to Newcastle" has long been a synonym for the improbable; but an English syndicate is now reported as being activly engaged in promoting a scheme to ship Belgian coal to England. They offer to contract for delivery in London at a price 60 cts. below present English prices, provided certain Belgian freightage rates are equalized. They are said to have $25,000,000 invested.

THE Berlin Trading Co. and Warschauer banking firm of Berlin have loaned the Chinese government about $1,250,000 (5,000,000 marks), at 5½ per cent. interest and 15 years to run. The German press is exultant over this first step gained in their vigorous efforts to finance the coming railways of China.

Prof. HILGARD, of the State University of California, warns the people of the Pacific Coast that land irrigation may be overdone. He says that more attention must be paid to under-drainage; and sustains his arguments by existing conditions in the irrigated plains of Fresno, Tulare and Hern, where there was formerly no moisture within 30 or 40 ft. of the surface, while water now is found almost anywhere within 3 to 5 ft. The roots of trees and vines have been forced to the surface and the alkali accumulating through centuries is also brought upward. He recommends as a remedy laws providing for the proper location and construction of the ditches.

Dr. KAUFFMANN has been experimenting for the Russian government in solidifying pretroleum for use as fuel. As reported his process is to heat the oil and then add from 1 to 3 per cent. of common soap and boil again for half an hour. The soap dissolves and then turns the liquid into a putty-like mass which is as hard as stiff tallow, when cold. The product is difficult to light, burns slowly without smoke but great heat, and leaves about 2 per cent. of a black, hard residium.

Street Grade Intersections.

BY F. A. CALKINS, M. AM. SOC. C. E.

A hard-and-fast rule for the gradients of intersecting streets is practically impossible; but by giving a number of examples of the actual practice in the City of New York, under varying conditions of topography, the author trusts that he may be of some assistance to engineers engaged in work of a similar character; and perhaps encourage others to put their experience and practice on record.

Nearly all of the illustrations selected represent extreme cases of angular and curvilinear intersecting lines, and a maximum and minimum variation in grades.

The improvement of streets and avenues in this city is now under the control of two departments. The Department of Public Works having charge of street improvements on Manhattan island (or that portion of the city southerly of Harlem river) and

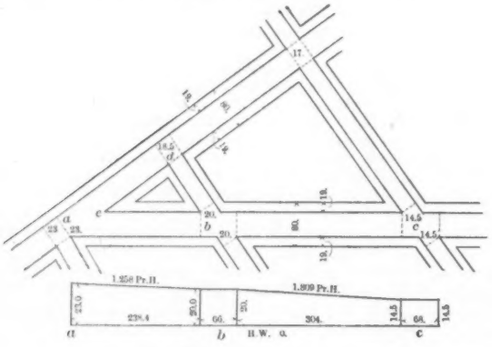

Fig. 1.

the Departments of Public Parks, the new district, consisting of the 23rd and 24th wards lying northerly of the Harlem river.

The areas of these divisions are nearly equal, the former having 13,463 acres, and the latter 12,317 acres.

The illustrations designated by the Figs. 1 to 4

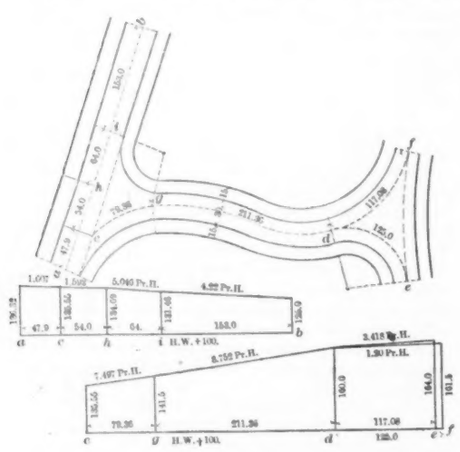

Fig. 3.

represent streets in the territory under the control of the Department of Public Parks. The streets presented in Fig. 1 are located northerly of Park Morris and near the Southern Boulevard. The grades shown on profile from a to b have a fall of 1.25 ft. per hundred; but the curb of intersecting streets at b being level, the grade line continues to a street at c with a fall of 1.80 per hundred, which has also a level grade. If the curb between b—c and e—d should follow the grade a—d and a—b, there would be a difference in the grade of 0.73 at e, or an elevation of 22.23 for b—e, and 21.5 for d—e; but if this grade is

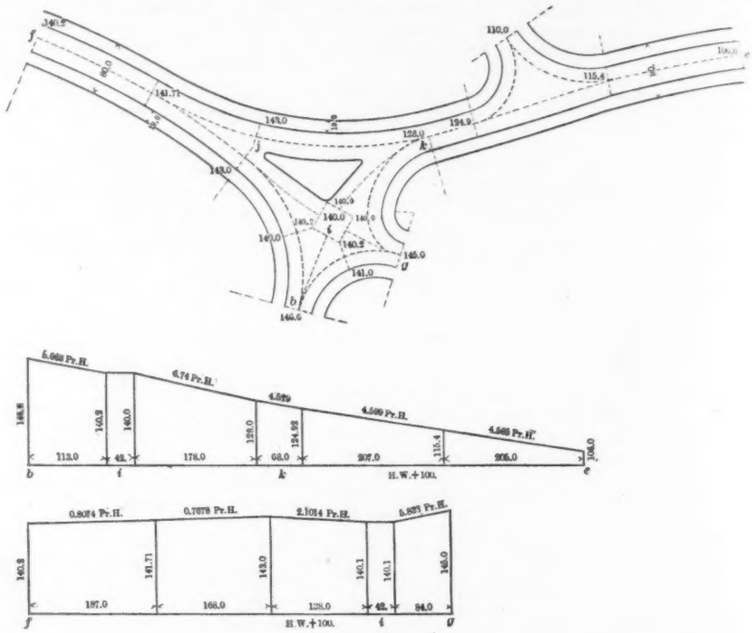

Fig. 4

modified, making the grade at e 21.87, the variation from the curb opposite, will only be 0.36. A preferable plan to obviate this would be to put in a circu-

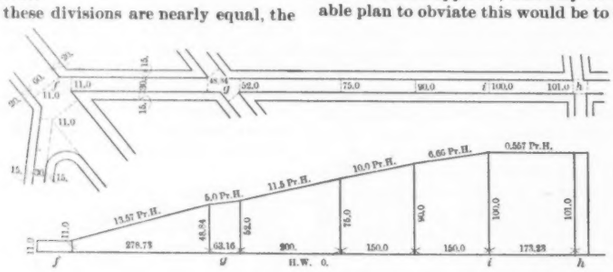

Fig. 2.

lar curb of 8 ft. radius having tangents of 25 ft. The difference in grade at tangent points will then be 0.94, and length of connecting arc, 21 ft., which would be ample for warping in this curb, and give more space to adjust the grade of pavement.

In Fig. 2 Bremer avenue is shown intersecting Central avenue at 161st. St. near McCombs Dam Bridge. The rise from Central avenue at f to Anderson avenue at g with a grade of 13.5 per hundred, is very abrupt.

A level grade for intersecting street at g is deviated from, on account of a grade of 51 ft. to be overcome between g and i, in a distance of 563 ft. or 9.56 per hundred.

The variation in grade of curb between lower and upper side of avenue at g is 3.16, in a distance of 63 ft. or a rise of 5 ft. per hundred. A street intersecting here at an acute angle permitted a level crossing to be departed from. From g to h the grade does not continue uniform, but is divided into four sections having a rise respectively of 11.5, 10., 6.66 and 0.57 ft. per hundred; the latter connecting with a level curb at h.

The examples given in Fig. 1 and 2, represent streets connecting at either acute or right angles, and with two exceptions only, one at e in Fig. 1 and the other at g in Fig. 2, the grades of the curb at connecting streets are level. Wherever angles of intersecting curb lines are acute, the grades are carried at right angles to opposite curb as indicated by dotted lines, and not to the intersecting angle opposite the initial point of grade.

Fig. 3 is located at the intersection of 184th street and Sedgwick avenue, which is near the Harlem River. In 184th street the rise from c to g in a distance of 79 ft. is 5.95 or 7.50 per hundred; but from g to d 18.50 in a distance of 211 ft. it is 8.75 ft. per hundred, leaving the grades between d—f and d—e comparatively light. In Sedgewick avenue from a to c the grade in a distance of 48 ft. is very light, being ouly 1.60 per hundred, connecting with a similar grade of 1.60 per hundred between c and h; between h and i there is a fall of 3.23 in a distance of 64 ft. or 5 ft. per hundred, and continuing to b with a fall of 4.22 ft. per hundred, in a distance of 153 ft.

The distance from c to d being 290 ft. with a rise of 24.50 ft., and from c to b 271 ft. with a falling grade of 10.55 has made special treatment necessary to connect the grades at g and i.

From c to g in 79 ft. there is a rising grade of 5.95 ft. or 7.50 per hundred; and from h to i, a falling grade of 3.23 in 64 ft. or 5 ft. per hundred, making the difference between the grades at g and i 10 ft. in a distance of 80 ft., equivalent to 12.50 per hundred;

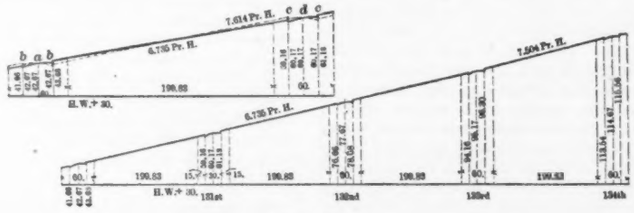

Fig. 5.

but if a gradient of 1 ft. per hundred had been adopted belween c and i, the variation from g would have been 7.13 instead of 10 ft., equivalent to a gradient of 8.90 per hundred in place of 12.50, giving material relief to the grade for the connecting curb between i and g; then the gradient from i to b would be changed from 4.22 to 6.12 per hundred.

Fig. 4 is situated near the Harlem river and also showing a portion of Sedgwick avenue extending from f to g and Kingsbridge road from b to e. The

changes in the grades from *f* to *g* in Sedgwick avenue are very light, except from *f* to *g* where there is a rise of 4.90 in a distance of 84 ft., or 5.83 ft. per hundred. From *b* to *e* there is a falling grade of 40.60 in a distance of 813 ft., which on account of intersecting streets is divided into six sections. From *b* to *i* the fall is 6.40 ft. or 5.66 per hundred, connecting with a plane adopted for the purpose of uniting with the grade of Sedgwick avenue. From *i* the grade drops 12 ft. to *k* in a distance of 178 ft. with a gradient of 6.74 per hundred. At *k* another change in the grade occurs on account of the intersection of a branch from *j*. The remaining distance is divided into two sections, the first having a fall of 9.50 ft. or 4.60 per hundred and the second 9.40 ft. with a gradient of 4.68 per hundred. The difference beeween *j* and *k* in a distance of 256 ft. is 15 ft. with a gradient of 5.86 per hundred. The triangular plat assists materially in warping the grades between *i*, *k* and *j*.

Curved lines have been adopted in preference to tangents for the streets and avenues in a portion of the new territory, wherever the surface of the ground is very precipitous in character, thereby giving material aid in the adjustment of such conflicting grades, as will often be presented by the varied changes in lines and grades, incident to the combinations at such points.

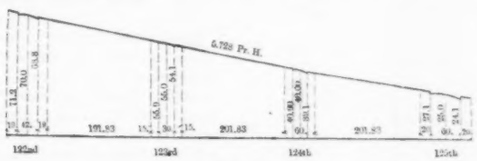

Fig. 6.

The illustrations from Fig. 5 to 12, are situated southerly of Harlem river. The Department of Public Works having control of that position represented by Fig. 5 and 6, and the Department of Public Parks from Fig. 7 to 12, the latter being within the limits of the Central Park.

The profiles in Fig. 5 and 7 represents a portion of

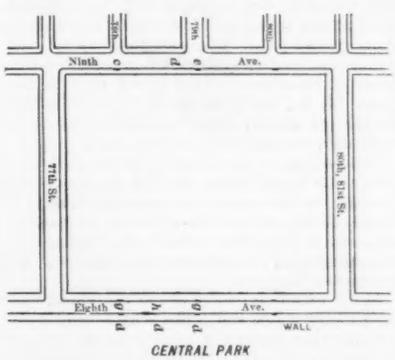

Fig. 7.

Tenth avenue, the numbered streets indicating location. Manhattan street passes through the lowest depression in Manhattan Valley, crossing this avenue at 126th street, with an elevation of 20 ft. above mean high water. The grade of Tenth avenue rises very abruptly both northerly and southerly from this point, the apex in the grade northerly is at 136th street, nearly 3,000 ft. distant, having an elevation of 136 ft. above Manhattan street. The apex southerly terminates at 117th street, a distance of 2,340 ft. and 118 ft. above this street. Fig. 5 is a profile of the grade from 130 to 134th street, with a rise of 17½ ft. between the centers of each street from 130 to 133rd, and 19½ ft. from 133 to 134th street. The former increasing with a gradient of 6.73 per hundred, and the latter 7½ ft. per hundred. The official grades are given at center of each street. The curb of intersecting streets is set with nearly the same proportionate rise as the official grades. The increase in official grades for a distance of 30 ft. the width of roadway at 130-131 & 132nd street is 2 ft., and the curb as set approximates to it; but at 133rd street the proportion would be 2.27, for the curb which is set with a difference of 2.40 ft. Fig. 6, represents the grades from 122nd to 125th street, increasing with a ratio of 5.72 per hundred, the difference of grade between each street being 15 ft. The roadway at 125th street has a width of 60 ft., and the curb set a difference of 3 ft.; but the ratio for the established grade is 2.47, which is diminished on account of the gradient from 125th to 126th street being only 2.49 per hundred. The ratio for a roadway of 30 ft., the width at 123d and 124th street is 1.72 ft. for the curb, which is set with a variation of 1.80. The ratio for 122nd street, having a width of 42 ft. is 2.40, with a corresponding difference in grade of the curb as set.

The examples given in Figs. 5 and 6 show that the curb of streets intersecting this avenue are set to the established grade and not level.

Mr. G. W. BIRDSALL, the present Chief Engineer of the Department of Public Works, states that a maximum variation of 12 ins. in the grades of curb for streets, at their intersection with an avenue or street having the controlling grade, was adopted by Mr. E. H. TRACY, a former Chief Engineer of that Department. The change of grade is now made at the intersection of curb lines, and not at the building line, a former practice.

Mr. R. VAN BUREN, Chief Engineer Department City Works, of Brooklyn, states that no variation is allowed by that Department at the present time, each corner being set to a level grade.

In Fig. 5 the upper profile is drawn to a larger scale showing a continuous grade line, with initial point of the grade at center of street (*a* and *d*), having a rise of 6.73 per hundred; and a dotted line with initial point in grade at *b*—*b* and *c*—*c*, with gradient of 7.61 per hundred. The full line represents the curb at *b*—*b* and *c*—*c* set to the slope of established grade; but the dotted line at these points shows a level grade, with the difference proportioned between *b* and *c*.

There is a serious objection to a falling grade at street crossings, which becomes prominent during a heavy fall of rain. The curved line at *b*—*b* and *c*—*c* shows the pavement practically without a crown to prevent storm water from flowing to the lowest grade point, which in this case would be a distance of more than 2,800 ft., concentrating a large quantity of water at two receiving basins, which would be divided equally between eighteen, if the curb were set level; permitting a crown to be made as shown by dotted line at *a* and *a*, breaking up the storm water into sections, thereby permitting each basin to do the share of work intended. If the maximum variation can be made 6 ins. at all the intersections on avenues and streets controlling the grade, with lines that are principally tangents, the crown of the pavement can be adjusted to distribute all storm water into each basin on the line. Where the grade of a large number of the intersecting streets is falling from the avenue controlling the grade, which occurs in Fig. 5, a portion of the flow will be distributed into the side streets, but when nearly all intersecting streets have a falling grade to the avenue, which is the case in Fig. 6, it will be impossible to retain filling in place, (before a pavement has been laid, which is the present condition here,) on a street with curb set to a uniform slope represented in Figs. 5 and 6, as well as failing to properly distribute the storm water previously referred to.

(TO BE CONTINUED.)

HERR KRUPP'S latest gun, just completed for the Italian government, weighs 121 tons, is 15¾ in. bore, the projectile is 4.2 ft., long and weighs over one ton; the range covered in the experimental firing was 7.44 miles.

A NEW ORLEANS "pine-distilling" company obtains from one cord of pine wood the following: 25 barrels of charcoal; 12 galls. turpentine; 15 galls. second-class turpentine; 40 lbs. acetate of lime and one barrel of tar. Total value of product, $16.95; total expense per cord of wood; $5.50. Rather profitable—if the returns are correct.

Municipal Engineering; Paper No. 4.*

PHILADELPHIA, PA.

(*Continued from page 120.*)

Board of Highway Supervisors.

The breaking of streets is under the control of a board consisting of the heads of the engineering departments, viz.: Highway, Surveys, Water, and Electrical, and the Superintendent of distribution of the Gas Works. The Chief Commissioner of the Highway Department is president of the Board, which meets every two weeks.

Following is an abstract of the rules and regulations:

"Written application for permits must be made, containing "a clear and concise statement of the object, nature, location and methods of construction of the proposed work," accompanied by:

"Certified copies of the laws and ordinances authorizing the proposed work.

"A certificate from the City Solicitor that the requisite security (if any be required) has been entered.

"A certificate from the City Treasurer that the requisite payments (if any be required) have been made.

"A certificate from the head of the department specially affected, that the laws and ordinances governing the case have been complied with.

"Five copies of the general plan showing the location of the proposed work, and, so far as shall be practicable, that of all structures existing in the same street or streets.

"Five copies of the detailed plans and sections, on an enlarged scale, of all important particulars.

"Such other information as may be required to enable the Board to reach a clear understanding of the whole subject."

Approval by the Board requires not less than three votes in the affirmative. Permits are then granted after the applicant has signed an agreement to be governed by the rules and regulations of the Board.

Before the street surface is broken, written notice must be given to the Chief Commissioner of Highways, and also the head of each Department whose works are likely to be met with, or encroached upon, and to the surveyor of the district, of the time, place and extent of the proposed breaking.

"No portion of any new structure, when in place in the street, except such as is designed to form a part of the street pavement, shall be less than 2 feet below the surface of said pavement; and the tops of structures forming parts of the street pavement shall have a roughened surface with projections rising not less than ½-inch, and spaced not more than 2½ inches apart.

"New work and new structures shall not interfere with existing pipes, sewers, conduits or other structures, or their connections, except where absolutely necessary, and, then only, with the previous consent in writing of the Head of the Department having charge of said existing structures. Any modification of existing structures found to be necessary, must be made by, or under the direction of, said Head of Department, and at the expense of the party having the permit. All necessary supports and protections to existing structures must be promptly supplied by, or at the expense of the party having the permit, and to the satisfaction of said Heads of Departments.

The Board may, when it deems desirable, appoint a special inspector to supervise the work at the expense of the party having the permit. Otherwise he shall employ the district surveyor to supervise, and in any case to record the location, and to certify to the correctness of a monthly return of all work done, accompanied by a complete plan showing details and any deviation made from the preliminary plan.

"All openings in streets must be promptly filled with suitable material, free from rubbish and perishable matter, and thoroughly and evenly compacted throughout by ramming in thin layers while being put in. The pavement must then be at once restored and maintained in good condition for a period not less than one year."

"Permits to make house connections for the supply of gas, water, heat, or drainage, or to make repairs to any of the above, or repairs to sewers, water, gas, or steam-pipes or conduits, may be issued by the department or departments having charge of the same, without previous reference to the Board of Highway Supervisors, provided the same be done under rules and regulations approved by the Board."

The works of the separate departments is still done independently of the Board of Highway Super-

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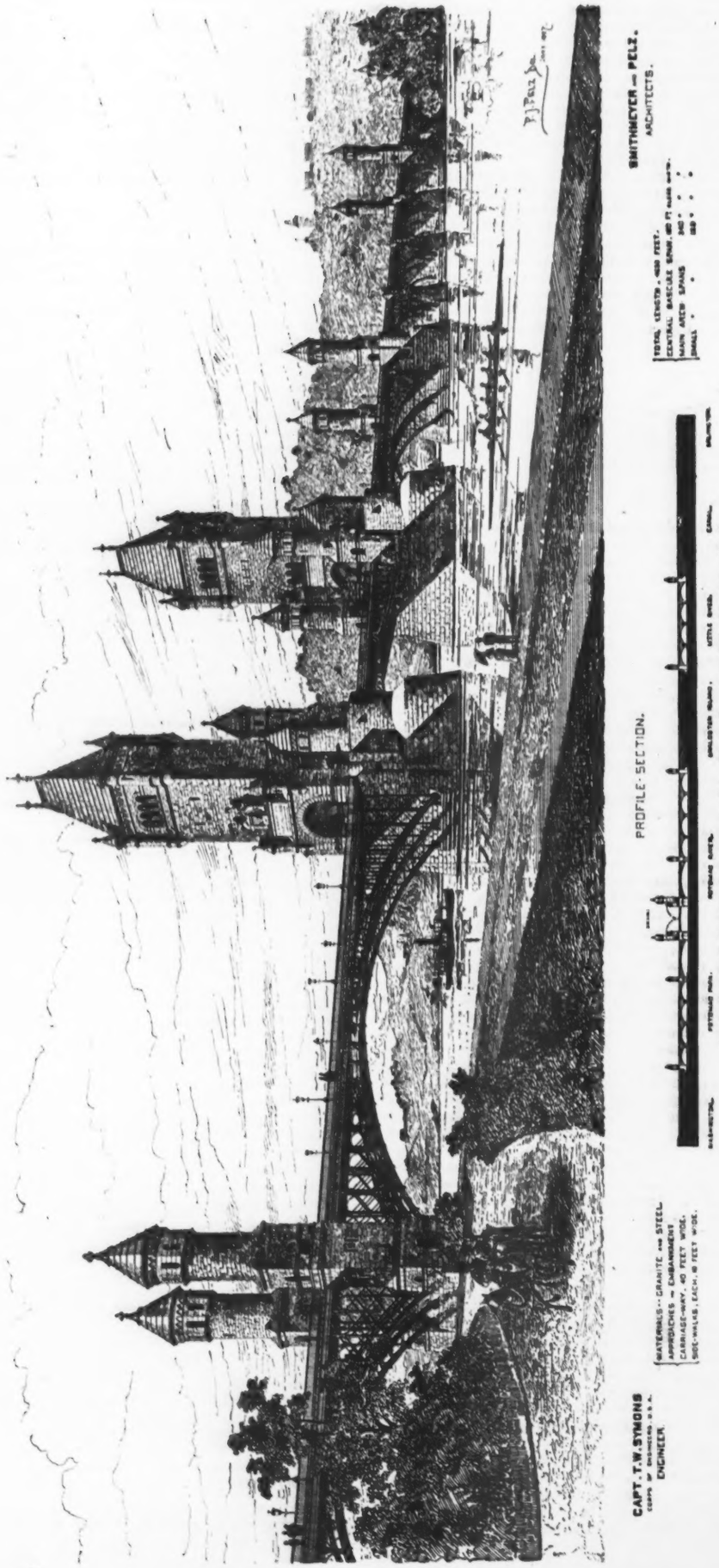

The Proposed Memorial Bridge to Gen. U. S. Grant, at Washington, D. C.

visors, each regulating its own work without conference with the others, and at such time as suits its convenience—except that paving is not done until sewers and gas and water pipe have been laid.

Board of Health.

The duties of the Board of Health are the registration of vital statistics, prevention of the spread of contagious diseases, execution of quarantine regulations, abatement of nuisances, registration of plumbers, supervision of house drainage and regulating the cleaning of cesspools. The last has already been referred to under Survey Department. The supervision of house drainage and registration of plumbers was commenced this year, and has naturally excited considerable opposition, since much scandalously poor plumbing had previously been done here.

(TO BE CONTINUED).

The Grant Memorial Bridge.

The illustration given herewith shows the structure referred to by the Hon. A. G. CURTIN, in a bill introduced in the House of Representatives on February 7, "For the erection of a national memorial bridge over the Potomac from Washington to Arlington."

The plans were prepared by Capt. T. W. SYMONS, U. S. Engineers, engineer and Messrs. SMITHMEYER and PELTZ, architects. The aim of these gentlemen has been to appropriately combine the three essentials of a memorial to Gen. GRANT, a highway from Washington to Arlington and a full and free passage for vessels using this navigable stream.

The monumental character is given to the bridge chiefly by the two central piers with towers rising 165 ft. above the bridge floor and 230 ft. above the water; each tower is massive in appearance, built of quarry-face granite and pierced for the roadway with triumphal arches of magnificent proportions. These tower-piers are 160 ft. apart in the clear, and between them is the draw span; which, in better conformity with the motive of the structure, is made in two folding-leaves, portcullis fashion. The roadway of the bridge proper will be supported on steel arches springing, just above the water-line, from granite piers. The arch form is adopted as being most conformable to the monumental character of the structure; the spans vary in length from 240 ft., next the central towers, to 120 ft. nearer the shores. The roadway would be 40 ft. wide with two side-walks of 10 ft. each.

This bridge would be located about half-way between the Long bridge and the Aqueduct bridge, crossing the river nearly on the prolongation of New York avenue, and in as direct a line as possible to the gates of Arlington. This is the best and most central location for communication between Washington and Virginia.

Mr. CURTIN in introducing the bill, stated that no more imperishable and suitable monument could be erected to the memory of America's greatest soldier, General U. S. GRANT. The design would be appropriate as symbolizing the restored Union, as the river crossed at one time divided the North from the South; it would also lead from the capital saved by General GRANT to the thousand graves of those men who perished in the struggle and now lie buried at Arlington.

The erection of the proposed structure would be in the hands of a commission composed of the Secretary of War, Chief Justice of the United States, the Chief of Engineers of the U.S. Army and a Senator and Member of the House designated by the presiding officer of each. No estimate is published of the ultimate cost; but the bill provides for $500,000 with which "to commence the construction of said bridge."

AMONG the curious railways in this country may be noted those temporarily crossing rivers on the ice. This was done in 1879 by the North Pacific crossing of the Missouri river; the ice was 3 ft. thick, and the mercury 20° below zero; loads of railroad iron were safely taken over. About 1880 a similar railroad crossed the St. Lawrence river at Hochelaga, and regular passenger trains crossed the Susquehanna river (2 miles wide) on the ice at Havre de Grace, Md., about 1860, for several weeks. In Sonoma Co. Cal., a lumber railroad was graded through a forest with a cross-cut saw, *i. e.* by sawing off trees at regular heights, and laying the ties on the stumps. Some of the huge redwoods were cut off 75 ft. above the ground, and utilized for trestles.

The Form of the Under Side of Rail Heads.*

When one is doing a certain thing for a certain end it is always well to count the cost, not necessarily as a first step to doing something else, but to at least know what we are doing it for. The younger generation of engineers and railroad men have almost lost the remembrance that we have ever had any other form of rail head than that shown in Fig. 1, which is the standard steel rail section (56 lbs.) adopted for the Cincinnati Southern Railway in 1874. Such a rail section as that shown in

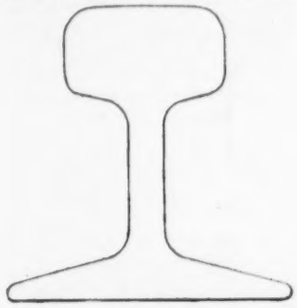

Fig. 1.

Original Standard Steel Rail Section, Cincinnati Southern Railway. Half Size.

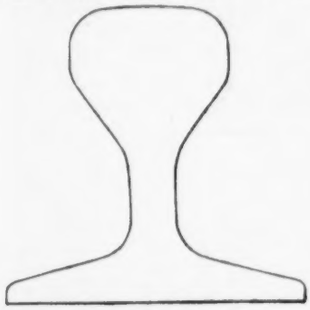

Fig. 2.

Original Standard Iron Rail Section, Cincinnati Southern Railway. Half Size.

Fig. 2, which was the standard iron rail section adopted by the same road at the same time has a strange and unfamiliar look. The fact that no other form of rail was heard of during the earlier decades of railways is all but forgotten, or if it be remembered, the change is ascribed in part to the progress of science and in part to the introduction of steel in place of iron rails. The chance that the change from the Fig. 1 type to the Fig. 2 type of section came about very nearly at the same time as the introduction of steel rails has helped to spread this impression, and it is possible that a large majority of those who have glanced at these two contrasting types on the facing pages of the Cincinnati Southern Report of 1875, have believed that their differences were chiefly due to the fact that one was for an iron rai and the other for a steel.

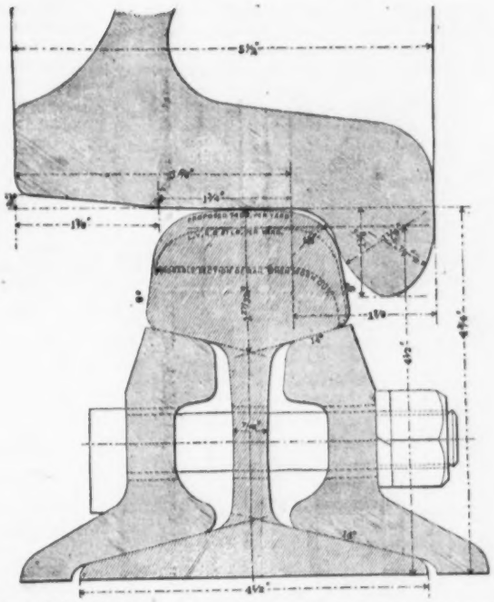

Fig. 3.—Original Lehigh Valley Standard Rail Section and Standard Wheel Tread.

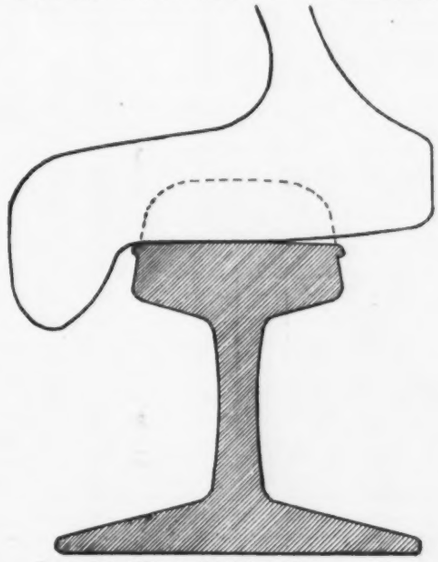

Fig. 6.—Typical Worn Section for Inside Rails on Curves.

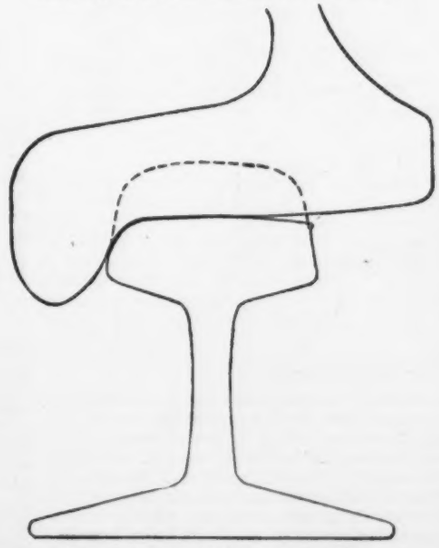

Fig. 7.—Typical Worn Section for Tangent Wear.

The historical fact however, is that the Fig. 2 type was introduced solely and only to fit the rail section for more efficient use with fish-plates, and the Cincinnati Southern contrast was due not to the difference in material, *per se*, simply to the fact that the iron rail was to be laid with one of the earlier forms of the Fisher joint and the steel rail with fish-plates. This does not necessarily imply that the Fig. 2 type is not in itself a better rail section, apart from the question of the joint, but it does do away with the presumption that it is an improvement, because it is a later form. The question then remains. IS IT AN IMPROVEMENT, REGARDED MERELY AS A SECTION FOR A CONTINUOUS RAIL, regardless of joints, or if not, what loss does it involve? Our remaining engravings are designed to shed light on this question.

In Fig. 3 we have what is probably the most perfect form of fish-plate, and of rail section to fit the fish plate, which has ever been devised, and as such we have chosen it. The bearing surface is large, and the transmission of the strains as direct and efficient as possible. Where as many styles of angle-bars break in great numbers, this does not break at all, it is stated, and the evidence seems clear that it is making the best record of any fish-plate joint now in use. The form of the top of this rail-section, in the detail of having so much rounded a corner, we apprehend to be mistaken and unfortunate, and provocation of early and rapid flange-cutting, even on tangents and easy curves, for a reason which is outlined in Figs. 11—12 and which we may glance at later. We are not now considering that point, however, but the form of its underside, and in that respect it probably cannot be improved on for use with angle-bars.

Fig. 3 shows both a light and heavy section, the latter designed last, in 1882, for reasons which were thus explained, at the time, by its designer, Mr. ROBT. H. SAYRE, now Vice-President of the Lehigh Valley.

"The new section is ¼-in. higher, and weighs about 74 lbs. per yd. It will be seen that as the base, stem and a certain portion of the head of the rail are not worn out, but that after wearing down, say ¼ in. of the head, the rail is renewed for want of sufficient strength, *any increase in weight put in the head would add materially more to the life and value of the rail than the increased cost.*

Assuming that the 67-lb. section may be worn down ½ in. we should have ¾ in. to wear down in the 74-lb. rail. This gives us just 50 per cent. more wearing value for about 10½ per cent. more weight."

Fig. 4 shows the result of two years wear of this section on the outside rail of a very sharp (14°) curve, with the joint shown in connection with the rail. To better appreciate what this cut indicates, as regards the inherent merits of the rail section merely as a *rail* section, regardless of what solidity at the joints requires, we must remember that the angle-bars only extend over 2 or 2⅔ ft. in every 30 ft. Fig. 5 shows the same section without the joint, or the conditions for nearly 92 per cent. of the length of the rail.

Again, we must likewise remember that outside rails on curves only constitute about 25 per cent. of the total, even on so crooked a road as the Lehigh Valley. About 50 per cent. of the rails are on tangents and the remaining 25 per cent. inside rails. In the latter case they wear very flat on top with a burr from flowage on both inside and outside. Fig. 6 shows the probable section for an inside rail at about the end of its life. On tangents the wear is much the same, except that the wheels impinge more or less from side to side so that the inside corner is at last rounded off, even with sharper cornered rails. Rails of this section wear well down the side almost immediately.* Fig. 7 shows the

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* The publication of this article, which was already in preparation, has been somewhat hastened by the publication in a railroad paper of this city of the following comments on the worn rail section shown in our Fig. 4 above, which we have re-engraved from its columns. As we have no desire nor intention of entering into controversial discussion, it appears superfluous to do more than to italicize in the extract below certain statements which we consider for one reason or another objectionable.

"The rail section of the Lehigh Valley, illustrated in connection with a worn rail in this number, brings out one point which has been made against splice bars; that is, that they made it impossible to use a pear-shaped head—assumed to be a constructively correct shape.

"This objection certainly did apply to iron rails which gave way by splintering off on the inside of the head. *It does not lie against steel rails, as is made clear by the wear which has here taken place.* The wear in this instance had not affected anything but the inside and upper faces of the rail-head, *which was perfectly intact below.* The specimens from which the cut was traced *does not show the least variation from the normal shape on the lower side of the head,* and the wear which has taken place has been made as sharply as if the head had been cut out by a planer, except on the top where flow has taken place *under the influence of heavy pressure.*

"*The deduction from this is that the splice angle might be made still sharper with advantage for wear, and any material put on below to give it the pear-shape would be practically thrown away.*"—*From the Railroad Gazette of Feb. 18, 1887.*

* Experience on the Pennsylvania Railroad has amply proved this. In various places on the parallel tracks of tangents, rails ten or twelve years old of the old sharper cornered section may be seen with no side-wear at all, when rails only a year or two old of the new round-cornered section are polished far down the side so as to give the appearance of track very tight of gauge, although it is not so in fact.

normal section of an old and worn-out tangent rail of this pattern, except that the head would probably have cut in somewhat more on the side.

Bearing all these facts in mind, let us see whether the shape of the underside of this rail-head is or is not an economical and good one MERELY AS A RAIL SECTION, apart from the question of joints.

In Figs. 8, 9 and 10, we have the whole question in a nut-shell. Leaving the top and upper corners of the rail entirely untouched, as an entirely distinct question, we have drawn in Fig. 8 a straight line diagonally across each side of the lower rail-head, tangent to the curve at the top of the stem and to a short curve of about ¼ in. radius just below the last point of contact of the flange. The areas thus cut off are hatched, and they amount, as nearly as may be, to 0.94 sq. in. or 9.4 lbs. per yd., or 12.7 per cent. of the total weight of the section.

The question now is: Is or is not the metal thus cut off useful to the rail *as a rail* or is it useful simply for furnishing a bearing for the fish plates? We will reject for the moment the case of outside rails, shown in Fig. 4, 5 and 8, and consider only inside and tangent rails on the outside of curves, being only 25 per cent. of the whole on the Lehigh Valley and rather less than 12½ per cent. as an average of the whole United States.

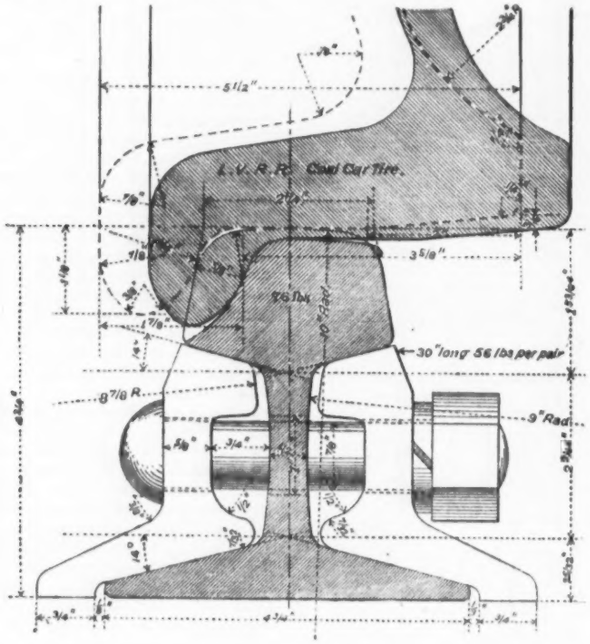

Fig. 4.
Lehigh Valley Worn Rail, after 2 years' service on 14 deg. curve. Half size.

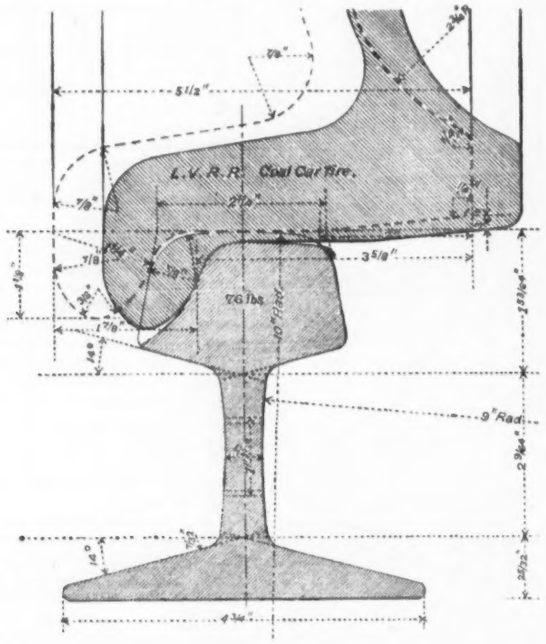

Fig. 5.
Same as Fig. 4, showing the Rail only, with all Joint Details removed.

For such rails, the answer must be that the shaded portion is in the main utterly useless to the rail, as a rail. It adds something to lateral strength but the rail does not lack for lateral strength. If is fails in that way, it is from lack of proper fastening to the ties. It adds something to vertical strength, but only about half as much as the same material would have, placed on top of the rail, for the reason that the radius of gyration of the shaded metal would then be twice as great. When the rail is nearly worn out, as in Figs. 6 and 7 it will be seen how much the useless metal on the lower corners would add to the life and strength of the rail if it were on top.

We come now to the case of the outside rails, as shown in Figs. 4, 5 and 8. In Fig. 8 it will be seen at once that the metal marked *b* and *c*, (or ¾ of the whole) has added absolutely nothing to the life of the rail, and but little to its strength, compared with what it would have done on top of the rail. The part *a*, however seems at first sight to have been useful in both respects.

In a certain sense it has, but in a truer sense it has been the least useful of all; so much so as to be on the whole positively injurious.

Fig. 9.
Transformed Section Lehigh Valley Rail.

To see why this is so we must remember that the wheel rolls on its tread, in a circle of 33 in. diameter or 16½ in. radius. The utmost wear which can be claimed to result from this *rolling* motion we have measured out for us in the slow rate of tangent rail-wear, but the wear really resulting from the rolling motion proper is greatly less than this, for this reason: It is well known that wheels run first towards one rail and then toward the other on a tangent continually. Every impact and rebound means a certain change of direction and hence a certain surface slipping, and hence a good deal of *sliding* wear. It has been determined, experimentally in at least one instance, by painting the nails, that these rebounds on a tangent indicate that the true path of the wheels is something like a continuous succession of reversed 2° curves, and evidence of a convincing character, which we cannot stop to give in detail, makes it at least probable that nearly all the tangent rail near results from this sliding, and little if any from the mere rolling motion.*

Fig. 10.
Original Section Lehigh Valley Rail.

Now returning to the worn metal *a*, Fig. 8, it will be seen that the flange which cuts it away is moving in a circle of considerably greater diameter than the tread of the wheel, and that consequently, whenever the flange touches the side of the rail it slides or grinds against it, and not simply rolls, as on top. At the upper point of *a* the radius is ⅛ in. greater,

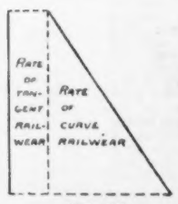

Fig. 13.

*Fig. 13 outlines the general method by which this result is reached. The normal tangent rail wear is known. The normal rail wear on various curves is also known. The amount of surface slipping which causes *the excess of curve wear over tangent wear* can be computed very approximately. From these data we can readily compute how much surface slipping would be necessary to cause the tangent wear at the same rate, which (speaking from memory only) is about that due to a 4° or 5° curve. It seems reasonable that what between oscillation and concussion, irregular diameter of wheels, trucks out of square, and what not, as much sliding as this can be accounted for as probably existing on a tangent.

or 17 in, at the lower point, over 1¼ in. greater, or 17¾ in.* This means that the flange is grinding against the *most favored* point of the area *a* at the enormous rate of

$$\frac{17.-16.5}{16.5} = \frac{0.5}{16.5} \times 100 = \mathbf{3.03\ ft.}$$

for every 100 ft. advanced, and against the *least favored* or (lower) point of *a* at the still more enormous rate of

$$\frac{17.75-16.5}{16.5} = \frac{1.25}{16.5} \times 100 = \mathbf{7.57\ ft.}$$

for every 100 ft. advanced. Contrast this with the insignificant rate of surface slipping even on such a very sharp curve as 14° (which is only *arc of* $14° \times \frac{\text{gauge}}{2}$, or 0.574 ft. per 100 ft. advanced, allowing the slippage to be evenly distributed between the two rails†) and we shall see why Fig. 11 must of necessity represent the conditions of minimum wear, since both the load and the flange-thrust are resisted by a

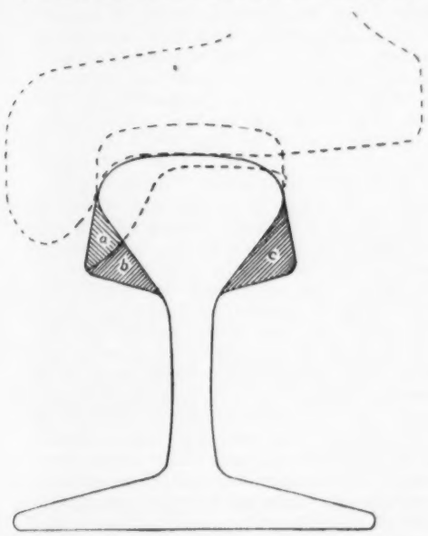

Fig. 8.

Section in Fig. 4, with the metal whose utility is in dispute shaded.

rolling contact. It is readily demonstrable that it does by records of actual rail wear, which show that the abrasion per 1,000,000 tons is only from *one-fourth* to *one tenth* as great at first as it is after the rail has taken the form of Figs. 3, 4 and 5. It follows that the metal marked A in Fig. 12 is in every sense of the word "precious metal" serving to postpone to the last day possible this severe grinding action, and that the metal marked *a* in Fig. 8 is in every sense

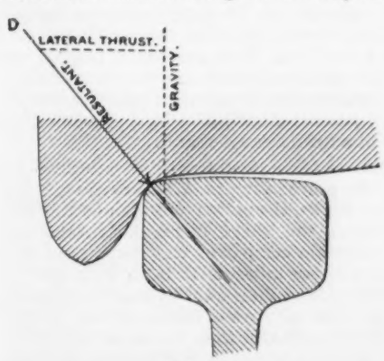

Fig. 11.

Position assumed by the Wheel under the combined effect of the Lateral and Vertical Forces; showing the condition of Least Wear for Rail and Wheel.

of the word base metal, seeing no useful purpose but to be ground off in great flakes by the first flange which touches it, adding correspondingly to the resistance and the danger of a wheel mounting the rail and to the flange wear of the wheel, but *not* adding appreciably to the life of the rail, because it is so quickly cut away when the wheel touches it.

It follows that none of the metal *a b c*, is advantageously placed for the life of the rail. Rather more than half of it should properly be charged up to the cost of the joint, and considered as a part thereof, and it amounts in all to 94 lbs. per 30 ft. rail.

For the good of the rail it should be sliced off the corners and put on top, as dotted in on Fig 8. This makes the rail disproportionately high, and to correct this, a corresponding amount should naturally be taken out of the web. This releases 0.20 sq. in., or 2 lbs. per yd. more, to put on top, and the net result of the whole process of transformation is shown in Fig. 9, with which may be contrasted, in Fig. 10, the original rail, stripped of all its accompaniments which might mislead.

A section made by patches from another, as was Fig. 9, cannot be expected to be a good one in detail, and it is not, but that it represents a far better type

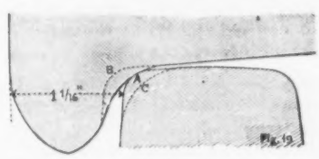

Fig. 12.

Showing (A) "Precious Metal" serving to postpone Flange-cutting as long as possible; (C) the form the rail must ultimately assume on the outside of curves; (B) the metal cut out of FROM 2 TO 8 PER CENT. ONLY of the wheels removed, and then only after a fairly long life and NEVER ON BUT ONE WHEEL OF THE SAME AXLE, the other being worn away from flange; showing that it is imperfections of track or wheel, and not the rail, which causes it.

for *rail* wear, apart from the joints, is thought to have been made clear. It is also a stiffer rail, (if the head were made somewhat wider and less in height, as it should be) because its radius of gyration is greater, although the two sections are of the same weight, and of the same height and width.

The subject invites further discussion, but our space does not. Unfortunately, to discuss such a subject worthily takes space, although a dozen lines suffices to make as many reckless assertions.

TECHNICAL NOTES.

MR. J. WM. DIBDIN, F. C. S., in his late paper read before the Institution of Civil Engineers, on "Sewage Sludge," said that for sewage purification iron sulphate used in conjunction with lime would effect as much work for $155,000 per annum as an expenditure of $410,000 for alumina and lime. As a general rule for sewage treatment, he stated that the sewage should be as little diluted as possible; the flow should be adjusted so as to agitate as little as possible the particles in suspension, and no pumpage should take place before precipitation. The speaker thought that deposit in deep sea water was the only feasible method of disposing of London sewage. He preferred permanganic acid to chloride of lime as a deodorizing agent; though the former was much more costly, it was more effective, was harmless, had no odor of its own, and the quantity required was small.

A paper recently read before the British Association describes a process in welding which is claimed to be new but which we apprehend is not entirely so. It consists in distributing evenly the borax or other substance used for flux upon a very flexible wire gauze, which is laid between the surfaces to be welded, the wires being welded in with the metals joined. This overcomes the difficulty of securing an even distribution of the flux, and allows a lower temperature than has always been considered necessary. A hammer-head of iron had a face of tool steel welded on it, and after six months' use in the shop it was found firmly joined. "To unite tool steel and iron is a remarkable achievement and marks an era in the blacksmith's craft," says the paper, but a still more remarkable thing has been done for a generation at one works in this country, viz., to weld tool steel to cast-iron.

This is done at the Eagle Anvil Works of Trenton, N. J. the property of Mr. CLARK FISHER of rail-joint fame, where something like two-thirds of all the anvils used in the United States is produced. By a process, which is kept secret, an absolutely perfect weld between the cast-iron body and the tool steel facing is secured, which endures through all the service of an anvils' long life. Not a little derision has been wasted abroad on the use of cast-iron anvils in the United States, on the assumption that they must be an inferior article, no foreign works being able to make such a weld. Really, however, it makes as good and a more durable anvil except for the one musical defect, that the anvil does not *ring* as well, for which purely æsthetic reason one-third of our people prefer the wrought-iron anvil.

NAPHTHA gas is being tested on the Brighton Beach Railway as a motor for street cars. A tank holding 15 galls. of naptha is placed on the roof and supplies a gas-generating machine on the front platform; the motor is on the rear platform. A speed of 8 miles per hour has been attained. The 15 galls. of naptha will last a day and cost $1.05, taking the place of from 4 to 6 horses.

MR. LEYSHON JONES, of Adelaide, N. S. W., claims to have successfully overcome the difficulty of cementing copper to iron plates intended for the bottoms of ships. Experimental plates have stood the test of actual service for some months.

PROF. SIR. WM. TURNER, of the University of Edinburg, has figured out that a whale 80 ft. long, weighing 74 tons and possessing a tail 18 to 20 ft. in extreme width, developes a propelling force of 145 horse-power in acquiring a speed of twelve miles per hour.

ACCORDING to the London (England) *Telegraph* the new mail treaty drawn up by representatives of the British government and the steamship companies will give a far better service than the old arrangement, the breaking up of which caused so much excitement. Under the new arrangement there will be four mails per week from England, the Inman line on Tuesday, the White Star line on Wednesday, the North German Lloyd line on Thursday (from Southampton), and the Cunard line on Saturday. This arrangement will go into effect on the expiration of the present temporary contract.

The second part of the agreement is of considerable importance; the Admirality has made a special arrangement with the White Star Company by which the service of its fleet is secured to the nation, at peace prices, in the event of transports being required; and the same agreement provides for the construction of new vessels by the company, of a type to meet naval requirements as armed cruisers. An annual subvention is to be paid in consideration of the owners building them to meet the admiralty designs. The engines are to be seated as low as possible and protected by the coal bunkers; there are to be a great number of water-tight compartments and the decks are to be strong enough to carry guns. The vessels will have twin-screws, powerful engines, and great boiler power. These boats are to be built at Belfast. A similar contract is to be made with the Cunard Company and Messrs. LAIRD are preparing designs for a new vessel for the Inman line which will be built in accordance with the Admiralty requirements.

A CORRESPONDENT informs us that the Kansas City Elevated road is "double-track, and superior to *any* other," and not single track, as we stated last week, according to an earlier published account.

FIGURES compiled by Mr. EDWARD ATKINSON indicate that the debt of the United States is only 73 cts. per acre, while the average of England, France and Germany is $30.06 per acre. In all Europe the proportion of men in the standing armies and navies (not including reserves) is 1 in 16. In the United States it is 1 in 322. The people of the United States produce the equivalent of $200 per annum for each man, woman, and child, England $175, France $120, and Germany $100. If these figures are correct, the proportion of national taxation to national product is 2¼ per cent. in the United States, 6.74 per cent. in England, 15 per cent. in France, and 12 per cent. in Germany. Italy, whose product is $80 per capita, pays 14⅔ per cent. for taxes. Her military and naval force is second only to that of Russia, or 765,820 men.

*The flange only shows 1¼ in. depth, but when the tread is worn it is much deeper, as are also locomotive flanges.

†It probably is not so distributed with any one train, but the outside wheel does all the slipping with freight trains as being the least heavily loaded and the inside rail with fast passenger trains, but this is an unimportant detail.

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AND

AMERICAN CONTRACT JOURNAL.

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D. McN. STAUFFER. A. M. WELLINGTON.
EDITORS.

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The Bush Interlocking Bolt Co. Bolts, Philadelphia Pa.
Elyton Land Co. Portland Cement Wanted. Birmingham, Ala.
Alfred Webb & Co. Foreman Wanted. Chattanooga, Tenn.
Beckwith & Quackenbush. Drills for Sale. Georgetown, D. C.
Isaac S. Cassin. Proposals for Water Pipe. Philadelphia Pa.
Lieut. Col. D. C. Houston. Dredging of Connecticut river. New York.
N. Monsarrat. Railroad Construction. Akron, Ohio
S. V. R. Townsend. Granite Paving. New York City.
Wm. M. Coomb. Draughtsman. Boston, Mass.
Proposals. Pages V, XII, IX, 148.
Wants. Page XII.

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WE learn this week that one of our foremost bridge engineers, a man of national reputation for the care and excellence of his designs, has recently abandoned altogether the plan of figuring out bridge strains to fit any specific engine wheel-base, and has adopted instead a uniform load of 3,000 lbs. per ft. + 30,000 lbs. concentrated load, which he declares to be a "decided improvement" on the engine diagram system, giving practically the same results as the latter and with far less trouble.

The credit of first suggesting this system belongs, we believe, to Mr. GEO. H. PEGRAM, and we think there is little doubt that it will speedily become the rule instead of the exception. When we come to running long trains of coal cars, weighing over 3,600 lbs. per running foot, as is done on at least one road in this country, and on the other hand to so many types of heavy engines that it is necessary to make the computations on three different engine wheel-bases in order to provide for all contingencies, the practice of attempting any greater precision with the engine load than the car load ceases to have any visible utility, while it has the very objectionable feature of giving an appearance of exactitude to the computations which is, in fact, beyond the reach of science, at present at least. This must have a tendency at least to encourage the the construction of bridges which are barely strong ehough for immediate necessities, a practice which saved much less money than is generally realized and shortens materially the life of the bridge.

WE have received several letters and suggestions as to the cause and possible course of events in the Woodstock disaster, but it appears profitless to discuss the subject any longer. One correspondent thinks that it could not have been the rail which derailed the train as "it seems hardly probable that the rear car in so short a distance would have left the roadbed in opposition to the centrifugal force." It is a way rear cars have, however, of leaving the rails in a very short distance and with scant respect for centrifugal or any other force, when they meet such a broken rail as we pictured.

Another suggestion, which comes to us from Scranton, is of more interest, that the bad rail was one rolled from what is called a "bleeding ingot," or one which had a small amount of molten metal still in its center when it first went through the roughing rolls, which was then squeezed out, leaving a cavity within which no amount of subsequent squeezing can weld together, or do more than stretch out, any more than the hollow in a glass tubes can be taken out, even if it be drawn down as fine as a hair. In well conducted rolling mills all such blooms are thrown out at once, but these rails were made from German blooms at an old iron rolling mill, where the nature of steel, it may easily be, was not well understood.

WE think that the suggestion of a bridge at Washington, as illustrated in this issue, is an exceedingly happy suggestion for a memorial structure to General Grant, and we congratulate the engineer and architects upon the thought and the good taste displayed in the plans submitted. It would serve a more useful purpose than any mere mass of monumental stone work and bronze; and as it would bridge the stream that once divided our country into two contending sections, its site would be very appropriate as a symbol of our restored Union.

We can not help suspecting however, that the same structural original inspired both the architects of this proposed bridge and the Tower Bridge, now building in London, which we illustrated in August of last year; at least as far as the central tower portion is concerned.

SIX or eight trains in succession have been blown completely from the rails in Colorado during the last ten days, a greater number than we ever remember to have heard of before within so brief a period of time. The record of none of them, however, quite equals that of the switch engine at East St. Louis, which was *lifted* from the rails and set alongside the track, still right side u .

Water-Works Construction in the United States.

The Statistical Tables of American Water-Works, the third issue of which has just been published by this journal, is well worthy of study as affording ample proof of the rapid growth, and the present importance of this class of construction in the United States. At the present date 1,402 water-works are known to be in operation, or so nearly completed as to be counted as such; and of this total *nearly one thousand* have been built since 1871. Between the year 1850-1860, 52 new works were constructed; in the period 1860-1870, the record was 79; in 1870-1880, it was 354, and in 1880-1886, 623 different works were actually put into service.

This very remarkable rate of progress has been brought about by a combination of causes. The rapid accumulation of wealth, increase of population and more intelligent ideas of personal comfort brought with them demands for a radical improvement upon the conditions and methods of preceding generations. Only a decade or two ago, the now recognized laws of sanitation were unknown, or at least little observed; town and house drainage were confined to the larger cities, and were generally in a crude and imperfect form, and a water supply from a well on the premises, or from a near stream, was considered good enough for the great mass of our population. But somewhere about 1870, the people began to realize that there was a limit to the filth-absorbing properties of the soil upon which their dwellings rested, and to the daily pollution of their source of supply, and a demand arose for improvement in their surroundings. The citizens of the smaller towns now concluded that their streets needed paving, that they should have water for fire-protection and domestic use, and the general introduction of water made systematic drainage a neccssity.

But as in many cases the erection of water works, with which we are especially dealing, by the citizens themselves seemed to be an expensive and rather risky venture, and was consequently delayed, the conditions of the times brought to their aid first of all the more enterprising among the manufacturers of pumping and distribution plant. These men introduced the now well known franchise system by proposing to build works at their own expense, provided that the town would simply guarantee to pay them for a specified number of fire-hydrants annually for public use and fire protection. This guarantee assured the projectors a minimum income from the new works immediately upon completion, and the town was benefited by being protected from fire at a fixed annual rental.

But as these first franchise ventures frequently proved very profitable to the builders of the works, the manufacturers now find imitators in the shape of regularly organized construction companies who have their own agents whose business it is to seek out the franchise, and their own hydraulic engineers to carry on the work of construction. According to the capital at their command these companies either bond the new venture and then market these bonds upon the possibilities of the scheme, or build the work first and then sell the bonds and stock at an enhanced valuation.

This active competition has also had a marked effect upon the efficiency, economy and cost of all manner of pumping plant and every other branch of supplies used in water-works construction. In this respect our country stands ahead of the rest of the world, thanks to an ever growing and daily more exacting demand and the mechanical skill and

business energy which our manufacturers have displayed in meeting this demand.

Having thus to some degree explained the reasons for the rapid growth and excellent character of our water-works, we will return again to the Statistical Tables. By arranging these statistics into groups of States we will gain some interesting information regarding the location of works and an explanation for certain conditions of apparent poverty in works that at a first glance might be wrongly interpreted.

If we first take the New England Group of States, viz.: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, we find record of 258 existing water works, or about one to each 240 square miles of the total group area. And the Middle Group of States, New York, New Jersey, Pennsylvania, Maryland and Delaware, has 388 water works, or about one to each 288 sq. miles of group area. But if we now pass to the South Atlantic States, viz., Virginia, North and South Carolina, Georgia and Florida, we find that there are only 54 water-works in the entire group area of 256,740 sq. miles, or one works to 4,755 sq. miles. We find, for instance, that there are only three water-works in the State of South Carolina, with its 30,170 sq. miles and a population of very nearly one million in 1880; while Rhode Island, with but little over 1,000 sq. miles of territory and, in 1880, only 276,531 inhabitants, has 15 water-works. New York, with about five millions people in 1880, has now 154 works; Pennsylvania has 168, and Massachusetts has 128. Taking again other Southern States we find that Mississippi and Louisiana have only two works each; Florida has 7; Alabama 10; and Georgia 12.

The explanation of this seeming poverty of water-works in the south is simple enough, though we lack the present population statistics to make it plainer still. The reason is that a public water supply implies a centralization of population or towns of a certain size. In the north, manufactures have gathered the people into frequent groups of greater or less density, and towns of very considerable size have been the result, and each town demands a supply. In the more agricultural south, on the other hand, the tendency has been to widely scatter the population, and beyond a few commercial centers, we have only modest villages. As a proof of this, we have only to take the census of 1880, the only available source of general comparison, and we will find that at that time South Carolina, for example, only had three towns containing over 4,000 population, and it now has a water-works in each; while diminutive Rhode Island with its fifteen existing works had nine years ago sixteen towns exceeding 4,000 inhabitants. In Louisiana, Shreveport, the only town in the State, excepting New Orleans and Baton Rouge, that meets the 4,000 limit, is yet without works; but it is there a question of supply, as the people forbid the utilization of Red River water, and the only other possible supply must be from a yet problematical underground source. Mississippi had four towns reaching the 4,000 limit and has but two existing works; and here we should say somebody wants water. Alabama had but four towns of the unit figure in 1880, but now has ten water-works, so that the towns have either increased rapidly in size, or, as is the fact elsewhere, smaller towns than the unit taken must be having their own supply.

Another important factor, however, to be considered in noting the frequency of water-works, is the general topography of the country. The New England and Middle States, for example, are undulating in surface, with frequent streams and miniature lakes of purest water that require the minimum of expenditure to impound and convey to the consumer. In many of the South Atlantic and Gulf States, on the other hand, potable water in quantity sufficient for a town supply is obtained, if obtained at all, at a great cost from deep artesian borings or by conduits from a distant source. The same difficulty exists in some of the western states, and will account for the absence of work at points where good water is much desired but practically unattainable with the means at command of the citizens.

The proper and economical management of water-works has also been receiving much attention in the past few years; and we now have two active incorporations, the American and the New England Water-Works Association, which meets annually to compare notes and exchange experience in all that pertains to the theoretical and practical control of works of this character. The effect of this association of workers has already been felt in increased efficiency and economy, and in the direction of more intelligent and uniform reports of work done and the controlling conditions whereby comparison can be legitimately made between various systems of management.

With the construction record of the past half decade before us, it is difficult to fortell the growth in the next few years; but with the fully organized and perfect business machinery now in operation in this country the increase will doubtless be enormous.

The growth of this one branch of construction in the United States is but another index of our vast increase in national wealth. Although at this date it is impossible to obtain the actual cost of more than 66 per cent. of the works enumerated in the statistical tables, yet this record shows an investment of about $285,000,000 in American water-works; or allowing the low average of $30,000 each for the 467 unvalued works now in operation, we have a total outlay of very nearly $300,000,000 for the works as they stand. The cost of maintainence can only be estimated at present, but must represent an enormous sum annually expended for labor and material. In another issue we will again refer to this subject and its importance as a factor in our material prosperity and comfort.

The Gun Question.

It looks very much as if the final outcome of the gun and sea-coast defence bills would shape itself somewhat after the method outlined in the late Annapolis paper on the gun question by Mr. E. BATES DORSEY. Mr. RANDALL, of the House committee has prepared a rough draft of a compromise bill proposing to create a Board made up of the Secretaries of War and the Navy, the Lieutenant General of the Army and two civilians, with another civilian to fill the vacancy occasioned by the death or disability of the Lieutenant General. This bill would authorize the purchase of a number of guns for test, and contemplates the establishment of a government ordnance plant. The sum of $5,000,000 will probably be set aside for the purchase of test guns, and cast-iron as well as steel is to be admitted to the competiton. An appropriation of $1,000,000 for the government gun plant, and other sums for torpedoes and dynamite guns will probably make the total of the appropriation about $10,000,000.

We heartily approve of the mixed character of the Board proposed by Mr. RANDALL. With all due respect to the officers of the army and navy, "the men who use the guns," are not on account of that fact always the best men to make them; to arrive at the most perfect design, it is necessary to combine in proper proportions the expert knowledge of the practical worker in the material selected with the experience of the user as to actual service under fighting conditions. By the term civilians, we suppose Mr. RANDALL to mean men versed in the manipulation and behavior of the material to be tested; and on this assumption the board suggested should include all the elements necessary for good and satisfactory work. Such a board should be thoroughly impartial, and above all things just in fairly testing all designs or material submitted, and fearless in pronouncing judgment. While intelligent use should be made of foreign experience, the mere opinions of foreign gun-makers should be taken in homeopathic doses. The conditions are not exactly similar, and we excel in some of the materials that might be used for such purpose; and moreover HERR KRUPP and others makers jealously guard some of the important secrets of their trade, and permit the world to know just as much as it suits them to make public—and no more. As we said last week, we now want the best guns attainable, and appropriate to our service, whether they be steel of high or low tensile strength, cast-steel or cast-iron. But we must institute a fair and exhaustive test among all materials and under all conditions of manipulation and design, a thing which has not yet been done, before we can be sure which is the best. We have an abiding faith in the American mechanical skill and inventive talent that has so often met the emergency of the hour, and would wish to see it fairly tested in this gun question. We one time made the best guns and best ships in the world; if it can be fairly proven that we have lost the power to duplicate this record then and only then let us blindly follow in the path outlined for us by possible foes, or buy our guns outright from England, Germany or France.

A Well Proved Claim.

One of the most extraordinary instances of sloppy and muddle-headed editing which we have ever chanced to see is contained (if our contemporary will pardon us) in *The Engineer* of Dec. 31, ult., where a claim is advanced in the first three lines which all the remainder of the article clearly disproves. The delightful absurdity of the article, and its amusing evidence of how firmly an English—

> "Man convinced against his will
> Is of the same opinion still."

can best be brought out by reprinting the claim and proof together without note or comment, omitting, (as we do) the unessential parts only of an article which, all told, is only a column long:

The Claim.—"It appears that not only the bogie, but the equalizing beam or lever *can be clearly proved to be English inventions*, though an American origin is often claimed for both of these useful adjuncts to rolling stock for rough permanent way."

The Proof.—"The first bogie used in America was placed in 1829 under some granite cars used on the Quincy Granite Railway, near Boston. These cars had two four-wheeled trucks or bogies free to swivel round a centre pin or king bolt, and side-bearings or friction plates. The cars were permanent, and not temporary structures.

"Conduce Gatch, a foreman on the Baltimore & Ohio Railway—then worked by horses—built some temporary cars for carrying firewood in April or May, 1830, consisting each of two four-wheeled cars or trucks, each carrying a swiveling bolster), and connected by three longitudinal stringers. Conduce Gatch also claimed that he built the first passenger coach carried on two four-wheeled bogies in July, 1831. Contemporary newspapers contain accounts of the trial trip of this car on July 3, 1831.

"The above are the earliest recorded uses of the bogie in the United States. *It appears to have been first used there under a locomotive in* 1832. In the patent suit known as the "Winan's eight-wheeled car case," *Mr. John B. Jervis, one of the best known American civil engineers, gave evidence that he invented a truck or bogie in* 1831, and that an engine with this bogie was put to work on the Mohawk & Hudson Railroad in 1832. A second engine on a similar plan was put in operation on the Saratoga & Schenectady Railroad early in 1833 The front end of the engine rested on the frame of a four-wheeled truck of the lower frame without necessarily being parallel with it.

"*Messrs. Robt. Stephenson & Co. built their first bogie engine in* 1833. THIS ENGINE WAS ORDERED, Jan. 12, 1833, FOR THE LINE REFERRED TO ABOVE, BY MR. JERVIS, the Saratoga & Schenectady. The engine was sent away from Newcastle April 6, 1833, and was set to work *in America* July 2, 1833. *It is often asserted that this engine, the "Davy Crockett," was the first locomotive with a bogie, but that is altogether a mistake,* AS SHOWN ABOVE.

"*The bogie engine seems to have been little known to English railway men until* 1839 *or* 1840. In the early part of the first-named year three bogie engines named respectively the England, Atlantic, and Columbia, *were sent to this country by Norris, of Philadelphia, for the Birmingham & Gloucester line.* They were tried in the first instance upon the Grand Junction, and were apparently not placed upon the railway for which they were intended until 184[illegible]. A notice of these engines is to be found in the *Proceedings* of the Institution of Civil Engineers for 1840, p. 46. In the *Proceedings* for 1843, p. 99, some particulars are given of another of Norris's bogie engines. *It is quite evident from the tone of these papers, and the subsequent discussions, that the idea was new to the most of those who took part in them.*"

Truly an Englishman never knows when he is beaten! A man who can knock himself down, and come up smiling in this fashion ought to be exhibited as a curiosity.

But there remains even a lower depth of absurdity for *The Engineer* to fall into, in the same article. If any man in England or in the world might be supposed to know all about the development of the locomotive in those days, it was its great inventor, GEORGE STEPHENSON, in whose works the first "bogie" locomotive was built in 1833 for Mr. JOHN B. JERVIS, as *The Engineer* has just told us. This is what Mr. STEPHENSON knew of this "English invention" is 1836, according to *The Engineer*.

"*George Stephenson, in his evidence before the House of Lords Committee, in* 1836, *said:* 'There is a contrivance I saw the other day for passing round curves, but it is by having a center to move on, so as to change the direction of the wheels to suit the curve like a gentleman's carriage; I thought it would not do.' This might not have been a bogie, but *Stephenson says not a word about the bogie engines made at Newcastle, although several questions were put to him about locomotives passing round curves.*"

The claim as to the equalizing lower—an invention of unquestionable American origin, first introduced by Messrs. EASTWICK & HARRISON in 1837 8, and by 1844 in universal use in America and nowhere else, is equally absurd, resting as it does, on a single patent specification for a "wagon" of a type of which there is no evidence adduced, nor probably existing that a single one was ever built.

We chance to have a shrewd suspicion of how this error came about, which, if our suspicion be correct, would make it something of an international episode, and "even a more excellent tale than the other," but we must content ourselves with giving merely the final outcome of the episode.

PERSONAL.

JOSEPH S. SCHOFIELD, late agent of the N. Y., N. H. and H. R. R., in New York City, was promoted to Superintendent on Feb. 23.

W. T. REED has been appointed Master Mechanic of the St. Paul, Minneapolis & Manitoba R. R., with headquarters at St. Paul, Minn.

MAJOR GENERAL A. DE C. SCOTT, R. E., has been appointed Examiner of the London Water Supply, in succession to the Late Sir FRANCIS BOLTON.

R. R. BRIDGERS, Jr., has been appointed Engineer of Maintenance of Way of the Western North Carolina division of the Richmond & Danville R. R.

W. E. HANSON has been appointed Superintendent of the Chicago division of the Minnesota & Northwestern R. R., with headquarters at Sycamore, Ill.

HENRY FINK, of the East Tennessee, Virginia & Georgia R. R. has been appointed Vice-President of the West Point Terminal and the Richmond & Danville R. R. system.

ENGINEER SHURTLEFF, of the Minnesota & Northwestern R. R. has taken up his headquarters at Galena, Ill., and will superintend the construction of the line from Freeport to Dubuque.

M. DE LESSEPS is reported as being about to publish his memoirs, in two volumes, and extending over a period of forty years. This should be interesting reading, judging his years of experience as a diplomat and canal-builder.

Engineers' Club of Philadelphia.

Record of regular meeting, Feb. 5, 1887. President T. M. CLEEMANN in the chair; 26 members present.

The secretary presented, for Mr. MORRIS P. JANNEY, a note upon the Differential Gauge as Used at Blast Furnaces. The appliance was devised by Messrs. TAWS & HARTMAN, Engineers, Philadelphia, for the detection of irregularities in the working of blast furnaces in the neighborhood of the tuyeres. "The instrument consists simply of a small glass U tube, or its equivalent, filled to proper point with mercury. This gauge differs from the ordinary blast gauge in having both ends connected to the blast pipe at different points, instead of having one end only attached. Between the two points of connection there is a slight obstruction placed in the blast pipe leading to each tuyere, so as to make a difference in the pressure at the two points of connection. When the tuyere is clear, the difference of pressure is greatest and the mercury in gauge stands at different levels in the two legs. If a tuyere becomes obstructed in any way there is less and less difference in the mercury level, until, if the obstruction is considerable, it becomes level, thus indicating a very much reduced flow of air through the tuyere."

At the instance, also, of Mr. JANNEY, attention was called to the recent discussion of the Effect of Saccharine Matter on Mortars.

Prof. L. M. HAUPT noted the Increased Weight of Locomotive Engines as Affecting the Strains on Railway Bridges, instancing the following dimensions of an engine recently constructed at the Baldwin Locomotive Works.

Number of driving wheels	10
Total wheel base of locomotive	24 ft. 4. ins.
Weight in working order, greatest on 1 pr. drivers	27,000 lbs.
On all drivers	134,000 lbs.
Total weight of engine	148,000 lbs.
Weight of tender	82,000 lbs.
Weight of locomotive and tender	230,000 lbs.
Capacity of tender; coal, 16,000 lbs.; water,	3,600 U. S. gallons.

Live load, 3,940 lbs. pr. ft.

Prof. HAUPT also referred to two recent legislative matters of interest to engineers; the Wheeler bill for the examination of the earth's crust, and progress in the matter of rapid transit for Philadelphia.

Engineers' Club of St. Louis.

Meeting of Jan. 16, 1887. Dr. WELLINGTON ADAM read a paper on "The Design and Construction of Dynamo Electric Machinery," which was illustrated by diagrams and electrical apparatus. The subject was handled in a thorough manner, and a number of formulæ were given, showing how the efficiency of any dynamo could be calculated. It was shown that these formulæ held the same relation to the dynamo machine that the indicator card does to the steam engine.

The president announced the subject of the paper for the next meeting to be the "Present Aspects of the Problem of the Inter-Oceanic Ship Transfer," by ROBERT MOORE.

CORRESPONDENCE.

A Correction.

SHELBYVILLE, ILL., Feb. 16, 1887.

EDITORS ENGINEERING NEWS:

In justice to all concerned, permit me to correct the error in your issue of Feb. 12, in regard to the stand-pipe at Shelbyville, Ill. It did not fall, nor was it wrecked as stated. There was simply a slight accident occasioned by the ice falling inside of tower, striking the overflow pipe near the base, and causing a small leak—direct pressure was used for a few hours only until the mouth of the overflow was closed. The stand-pipe was not in the smallest degree damaged.

Very respectfully yours,
E. J. SNOW,
Vice-President S. W. Co.

[We take pleasure in publishing the above, which explains itself. Our news item was taken from one of our Western exchanges under the impression that the case was as stated. —ED. ENG. NEWS.]

House Numbering.

Battle Creek, Mich.
FEB. 16, 1887.

EDITORS ENGINEERING NEWS:

Having in mind the difficulty of inducing citizens to renumber their houses in case of change in existing systems, a plan has recently been adopted in this place which worked so successfully that a description thereof may be of interest to your readers.

In former times the town had one number appropriated to each 44 ft.; experience here and elsewhere taught us that this system was liable to create trouble, especially upon business streets, and the unit space was therefore reduced to 22 ft. in the late renumbering. Next, numbers were prepared by printing them upon good tough tag-paper in slips 2 in. high by from ¼ to ⅝ in. wide, each number from 1 to 0 being on a separate tag. Tin boxes with a separate partition for each number were then provided and holes were pierced for 1½ oz. tacks (¼ in. long) by which to attach them to the property. Circulars were also left at each house explaining the necessity for the renumbering and urging owners or tenants to put up a permanent number at an early date.

In putting up these new numbers a party of three men was required; two of these did the measuring and the third tacked up the temporary number. The tape or chain used was marked plainly in lengths of 22 ft.; and commencing at the property abutting on a cross-street the appropriate number for each 22 ft. division was marked with red chalk upon the fence or sidewalk and the number and property recorded. The third man then arranged the proper tags in the tin-holder and tacked the latter upon the house; usually removing at the same time the old number. One party of three men can easily by this system renumber a town of 10,000 inhabitants in one month.

In our case the new notation went into effect at once; there was no blundering, for the new numbers were all on the houses about the same time and with few exceptions the old ones were removed. It was a success from the start.

Yours truly,
W. W. BRIGDEN,
Chf. Eng. Board of Public Works.

Fast Tunneling Compared.

NEW YORK, Feb. 23, 1887.

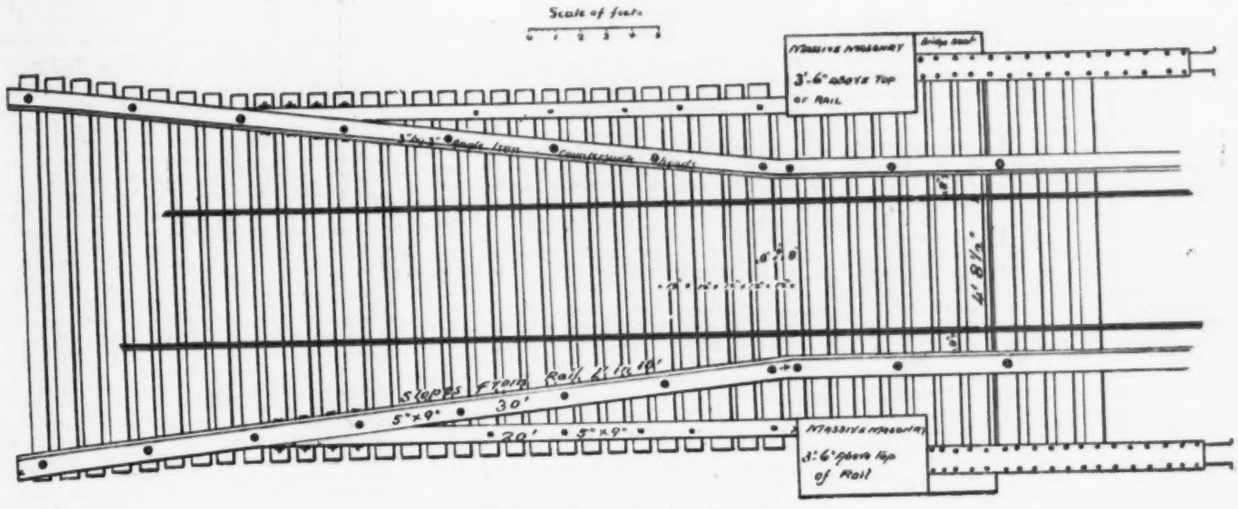
EDITOR ENGINEERING NEWS:

In your issue of February 12, you publish a column showing what you are pleased to call "Exceptionally rapid tunnel driving at Shaft 15, on the New Croton Aqueduct Tunnel." Permit me to compare this record with records made on Section A, at Shafts 22 and 23. These records were published in the ENGINEERING NEWS in July, 1886.

Tunnel Progress at Shafts 22 and 23.	Tunnel progress at Shaft 15.
Greatest progress made at Shaft No. 23, north, 254 ft. 6 in.	Greatest progress made at Shaft No. 15, north, 248 ft.
Number of days consumed in making this progress, 22.	Number of days consumed in making this progress, 24⅝.
Greatest progress made at Shaft No. 23, south, 265 ft. 6 in.	Greatest progress made at Shaft No. 15, south, 326 ft.
Number of days consumed in making this progress, 26.	Number of days consumed in making this progress, 25.
Greatest progress made in one week, 83 ft.	Greatest progress made in one week, 90 ft.
Size of tunnel driven, 12½ ft. x 12½ ft.	Size of tunnel driven, 8 ft. x 18 ft
Rock per lineal foot of tunnel, 6.47 cu. yds.	Rock per lineal foot of tunnel 3⅛ to 3¾ yds. Average 3.63.
Rock drills used, Ingersoll "Eclipse."	Rock drills used, Rand "Slugger."

The foregoing is susceptible of analysis as follows

Average cubic yards per lineal foot of progress at Shaft 15,..... 3.63



Standard Bridge Guard Canadian Pacific R. R.

Average cubic yards per lineal feet of progress at Shaft 23,.....	6.47
Greatest monthly record at Shaft 15, in 25 days (326 ft. at 3.63 per ft.),.....	1,183.4 cu. yds.
Greatest monthly record at Shaft 23, in 22 days (254.5 ft. at 6.47 per ft.),.....	1,646.6 cu. yds.
Difference in favor of record at Shaft 23,	463.2 cu. yds.
Average daily record of Shaft 15, ...	47.3 cu. yds.
Average daily record of Shaft 23, ...	74.8 cu. yds.
Greatest weekly progress at Shaft, 15,..	90 ft.
Material removed, ...	327 cu. yds
Greatest weekly progress at Shaft 23,....	83 ft,
Material removed,.....	537 cu. yds.
Difference	210 cu. yds

No one would of course dispute the fact that it is harder to drive the heading than to bring up the bench, but those familiar with this kind of work will admit that there are many reasons why great progress might be made in the heading where the bench is entirely neglected. A tunnel is a confined space where a limited number of men can work, and when the bench and headings are both driven together, the work upon one necessarily retards that upon the other. A contractor who drives 83 ft. of completed tunnel, 12¼ ft. x 12¼ ft. is surely making greater progress than one who drives 90 ft. of heading alone, 8 ft. x 16 ft. in the same time.

Yours truly,
W. L. S.

Bridge Guard.

NAPANEE, Ont., Feb. 17, 1887.

EDITOR ENGINEERING NEWS:—

I enclose a tracing showing the system of floor used on all bridges on the Ontario & Quebec Division of the Canadian Pacific Railway; the through bridges are pin-connected Pratt trusses, with collision struts, stiff hip vertical and with the two end panels of lower chord stiff members. The heavy wall of masonry built in front of the end posts forms a most efficient guard and while there is no re-railing device, a run off on one of these bridges must not prove to be such a very serious matter as in most cases. I believe this plan of protecting the end posts by heavy masonry is due to Mr. P. A. PETERSON, C. E., engineer of the Eastern Division of the Canadian Pacific R. R.

Yours truly,
M. J. BUTLER.

[If our correspondent will pardon us, all that merit which a fine stone arch has, *lacking only the keystone*, this plan of bridge protection seems to have. It cannot be improved on except by adding the one little feature of the cast-iron re-railing frogs which is as important as a keystone for the greatest efficiency of any such device, adding only some 20 per cent. to the cost, but doubling and trebling its value as a safeguard.

Perhaps we might add a query as to what will become of that "massive masonry" if a car strikes it, and of the car and the bridge as well? Will its "massiveness" be of much more avail than to furnish a convenient projectile to knock down the bridge with and let the car into the river? It would seem as if a post 20 ft. further back, would be both better and cheaper, even if not quite so pretty.—ED. ENG. NEWS.]

Self-Reading and Vernier Rod.

LAKE VILLAGE, N. H., January 17, 1887.

EDITORS ENGINEERING NEWS:

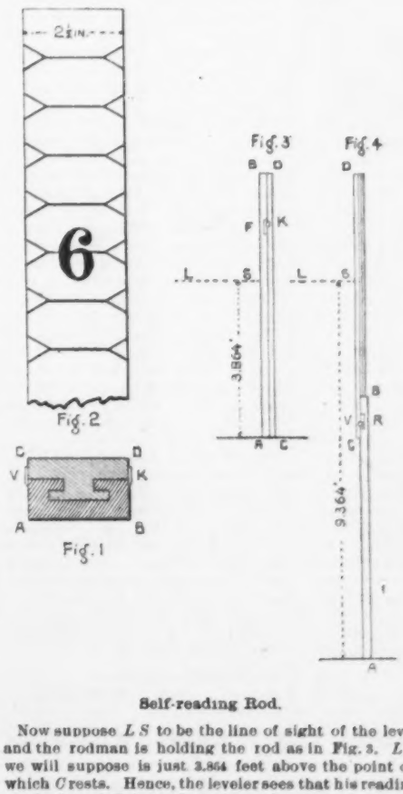
Having seen a number of different forms of level rod illustrated in late numbers of the ENGINEERING NEWS, I send you the enclosed sketches of a form which I have found superior to any other for all classes of work. Much of the levelling which engineers are called upon to do can be better and more expeditiously done with the self-reading rod than with the target rod, but in hydraulics he may be called upon to run levels to thousandths of a foot, and it is often convenient to have the means at hand to do so on other classes of work, and he must then resort to some form of target rod or confine himself to quite short sights with a well graduated rod like the New York so as to be able to read it with the instrument as finely as he desires his levels.

The object of the rod here illustrated is to furnish the engineer with a self-reading rod for all kinds of work and a rod also that can be used for all purposes to which a target rod can be applied, and is moreover far superior to the target rod in rapidity and much less liable to error by a mistake in reading. A cross-section and elevation of a portion of the rods are shown by Figs. 1 and 2, while Figs. 3 and 4 show the rod as in use. The rod is identical with the Boston rod in form, but has no target and is made wider, being 2½ inches wide. The part *A B* slides on the part *C D* like the two portions of a Boston rod. The face *A B* is painted white and divided off in feet and tenths, being numbered from zero at *A* to 6.50 feet at *B*, the total length of the rod when not run out. The face *C D* is painted white and divided off the same way and numbered from 5.50 feet at *C* to 12.00 feet at *D*.

Fig. 2 shows how I have graduated a rod of this kind which I have made for my own use. Each tenth mark is shown by a black line extending over the central portion of the rod and flanked at each end by V-shaped marks extending out to the edges of the rod, by which arrangement the eye clearly determines when the cross wires of the instrument are exactly upon a tenth mark of the rod as the V space is then bisected by the wire. I number the feet and mark the half foot divisions, but every other tenth can be numbered if the leveler prefers. The method of marking also can be varied to suit the taste of the user, taking great care, however, to adopt some method that will enable the leveler to determine exactly when the cross wires of the level and a tenth mark of the rod coincide.

For all ordinary work when a self-reading rod is sufficient but little explanation of this rod is necessary. For reading up to 6.50 feet the face *A B*, (Fig. 3) of the rod is exposed to the sight of the level. If a greater reading is necessary the rod is turned about and the portion *C D* is run up by the rodman until the end *C* is just 5.50 feet from the end *A*, determined by marks placed on the rod or by the zeros of the vernier and scale hereafter described or by a spring-catch in the rod which stops it at the proper point. The graduations on the side *C D*, then read correctly for any height up to 12.00 feet.

A clamp, like the Boston rod clamp, will be a very useful attachment at the upper end of the part *A B*, as the rod can then be clamped in proper position and constitutes a plain self reading rod, 12 feet long. When readings finer than hundredths of a foot are required, the following attachments are placed on the rod. At *F*, Fig. 3 on *A B*, a scale 0.20 feet long and graduated to hundredths of a foot is let in flush with the surface of the rod. (Figs. 3 and 4, both show the rod in side elevation as the rodman faces it when in use). At *K* on *C D* is placed a vernier scale reading the *F* scale to thousandths of a foot and so placed that when the ends *A* and *C* are exactly flush, the zeros of *F* and *K* coincide.



Self-reading Rod.

Now suppose *L S* to be the line of sight of the level and the rodman is holding the rod as in Fig. 3. *L S* we will suppose is just 3.864 feet above the point on which *C* rests. Hence, the leveler sees that his reading on the face *A B*, is 3.8 feet plus a fraction of a tenth. He motions the rodman to raise the rod and the latter raises the part *A B*, sliding it on *C D*, allowing *C* to rest on the point, and the leveler has the rod moved until his line of sight coincides exactly with the 3.8 feet division on the face *A B*. It is evident that this will only happen in the supposed case when the part *A B*, has been raised just 0.064 feet, and that the vernier *K*, will then read 0.064 feet giving, therefore, the reading with as much precision as any target rod. If the reading is more than 6.50 feet, the rodman turns the rod as in Fig. 4 and raises the part *C D*, to 5.50 feet above *A*, the end *A*, resting upon the point whose level is to be

determined. *R* is a scale precisely like *A* and *V* a scale like *K*, they being on the other side of the rod from *F* and *K*, as shown by Fig. 1. *V* and *R* are so placed that their zeros coincide when *C* is 8.50 feet above *A*. Then *L S*, being as before the line of sight of the level and being supposed to to be 9.364 feet above *A*, the rodman first presents the rod to the leveler with the zeros of *V* and *R* opposite each other, and the leveler sees he has a reading of 9.3 feet plus a fraction. By raising the part *C D*, until the line of sight is exactly on the 9.3 feet mark of the rod the reading of vernier *V*, will evidently give 0.064 feet, the fraction required.

It has been said above that this rod can be used more rapidly than any target rod, and this is evident from the fact that the rodman never has to move it more than 0.10 feet to get a reading. There is less liability for error in reading, also as the leveler himself reads the feet and tenths directly from the rod, and can check his rodman on the hundredths also, and the rodman concerns himself only with the hundredths and thousandths. Every tenth mark on the rod serves the purpose of a target, and, hence the condition of marking insisted upon above, that it shall enable the leveler to determine with great precision when the level cross wires coincide with a tenth mark.

The form of graduation in Fig. 2 is not given as being the best for all purposes, but was adopted as best suited to the purposes of my own rod. The Texas rod of Mr. Lynch can easily be used in this way with the addition of a secondary scale and vernier as, *F* and *K* in Fig. 3, and a secondary rod to be placed on the back of the rod with ordinary wood screws through slotted holes, if no better arrangement is at hand the slots being long enough to allow a motion of 0.10 feet. The rod illustrated here can be improved as before suggested by a clamp at the upper end of the part *A B*, and also by a spring catch, which will stop the part *C D* at zero of the scale *R* when it is raised, but which can be easily sprung down by the rodman, to take fractional readings when necessary.

This form of rod is probably best adapted to city work, and for railroad work I should make a common self reading rod, and have a secondary rod that can be attached to the back when fine work is to be done, and the fractional readings taken by sliding the rod on the secondary piece. My own rod I made go with an outfit which I designed to pack in as small compass as possible. The rod itself is 2 inches wide, by ⅝-inch thick, and 12.10 feet long, in three sections which are 4.05 feet, 4.00 feet and 4.05 feet long successively from bottom to top so that the joints come *between* tenth marks an important point in making the rod.

The joints are secured by brass plates, bolted to the back of the rod. When unjointed and packed together the same brass plate will bolt onto the sides of the pieces and hold them firmly in one bundle about 2 inches by 3 inches square over all and 4.05 feet long. My transit rods are each made of ¾-inch wrought-iron pipe, 6 feet long, in three sections, with screw joints and a steel point all fitted flush, so that it makes a rod about ⅝ inch outside diameter painted red and white as usual, and when bundled for transportation they make a bundle only 2 feet long. By means of two brass castings properly fitted I can attach one of the transit rods to the back of the level rod placing the transit rod point end up so as to get a good bearing surface on the ground, and I then have a scale on the back of the rod and a vernier on the transit rod by which fractional reading can be taken. A clamp is also provided to fasten the level rod at any fraction desired and at zero on the fractional scale when that is not needed for use.

For ordinary leveling of course, the transit rod is left off entirely, but by these simple attachments I can transform my small and compact self reading rod into an instrument more convenient for use than any target rod and equal to any of them in precision. There are no patents covering this design, and no rods of this kind are made by any manufacturers, but engineers can easily get one up for themselves, and one will find he is paid for doing it if he has much fine leveling to do. If any readers do not fully understand from this how to make such a rod, I shall be glad to answer any questions sent me by members of the profession.

Very truly yours,

W. E. BUCK.

Statistical Tables of American Water-Works

SHARON, MASS., FEB. 21, 1887.

EDITORS ENGINEERING NEWS:

"Statistical Tables of Water-Works" just received. I notice two slight errors. The works at Sharon, Mass., pump to stand-pipe and not to tank as you have it. On page 108, "Pawtucket, R. I.," should read Pawtuxet, R. I. I send you some notes on the Stoughton water-works which may be of benefit to you.

Yours,

W. B. WICKES, Supt.
Sharon Water-Works.

NATURAL GAS.

A Monograph.

BY CHAS. PAINE.

(*Concluded from page 70.*)

Mr. George Westinghouse, Jr., had developed the same difficulties in the making of tight joints for the transportation of air under high pressure. Becoming interested, through the discovery on his land of the most violent gas well which has ever been struck, in the transportation of that gas for the supply of consumers in the city of Pittsburg, he gave his attention to the matter of providing the necessary safeguards against the leakage, which he knew to be inevitable and very dangerous, if the gas was to be conveyed at the high pressures, which would alone admit of its cheap transportation over long distances, and of its distribution through such great areas, as were necessary for the supply of that city. He, accordingly, devised and patented several methods of entrapping and carrying away, by escape-pipes, the gas which would leak from the best joints which it is possible to make; perfecting his system by the purchase of the patents of others. This system of escape-pipes employed by the Philadelphia Company, of which Mr. Westinghouse is President, and which is the largest supplier of natural gas in the world, will be described in this paper, as the most noteworthy feature in the art of transporting gas, from an engineer's point of view.

First. As to Pipes and Joints; the screwed joint upon the wrought-iron pipe, is the best and tightest joint that has been made; yet even this will leak when filled with so ethereal a fluid as gas; and under the pressure of eight or nine pounds to the square inch (or fifteen pounds to the square inch, which is allowed by the ordinances of the city of Pittsburg) this leakage must be very considerable, and it is likely to be aggravated or increased by the variations in temperature, the settling of the ground in which pipes are laid, and many other occurrences. The screwed joint, however, is not as yet made satisfactory upon pipes of a larger diameter than 8 inches; accordingly, for larger wrought-iron pipes than this, up to 16 inches, the Philadelphia Company uses a leaded sleeve-joint, known as the Converse joint, reinforced by wrought-iron rings shrunk upon the outside of the cast iron sleeve. For larger pipes than 16 inches in diameter, cast-iron pipes are employed, tested to a pressure of 300 pounds to the square inch; not because they have to resist such an interior pressure, but because pipes of this strength have been found capable of resisting the wear and tear of life under disturbed streets.

In all streets or near dwellings, the screwed joints of the pipes are each surrounded by a conical heap of broken stone, which is covered by a sheet of heavy tarred paper, perforated at the top for the admission of a trumpet mouthed pipe, to collect any gas which enters the heap of stones, which rises a few inches above the heap of broken stones, and communicates with a horizontal line of escape pipe carried parallel with and over the main gas pipes. This escape-pipe is carried, at frequent intervals (say every 200 or 300 feet) to a lamp-post in the sidewalk, through which the gas, which has been collected in the escape pipe, is discharged into the open air at a point where it can do no harm. In some instances, these lamp-posts are lighted, to serve as *torches* for illuminating the streets; or they are surmounted by lamps, in which a regulated flame burns continuously, giving light by night, so long as there is any gas escaping from the mains. This arrangement has been found to afford entire security against the leakage from the small lines, which might otherwise have penetrated into adjacent vaults and cellars, where it would form a dangerous explosive mixture, liable to be ignited and destroy lives and property; as has been shown by much experience in Pittsburg and elsewhere, before this open means of escape for the gas which leaks from the joints had been contrived. The piles of broken stones, provided with an escape-pipe, as described, collect much other gas than that which leaks from the pipes or joints, for which they are prepared as a security; almost always taking up quantities of illuminating gas from the ground, especially when the surface is frozen, so that the porosity of the soil of the streets is destroyed. In other joints than those of the screwed pipe, the safety device employed is a casing around the joint to be protected, forming a chamber in which is collected all the gas which may leak from the joint; the leaking gas being led from this chamber up to a line of escape pipes by a small tube, screwed into the casing and communicating with the chamber surrounding the joint; each joint is thus put in communication with an escape-pipe, which is divided into sections from 200 to 300 feet in length, and discharged into the air by a pipe connecting it with a lamp-post in the side-walk. From each joint, the vertical pipe continues by a cross above the horizontal escape-pipe to within a few inches of the surface of the street, where it is surmounted by a cap, by unscrewing which each joint can be examined as to the amount of its leakage, with the smallest possible disturbance of the road-bed; so that if any lamp-post is found to yield gas in considerable quantity, it is very easy to determine at which joint the leak occurs; and the leak may generally be remedied by filling the casing, around the joint, with a liquid preparation of asphaltum under pressure, which enters the interstices of the lead joint, and solidifies there. The residue may afterward be pumped out of the chamber, leaving it prepared to receive any leaking gas, as before. Inasmuch as the casing itself may leak some gas into the surrounding earth, because of the imperfections in its joining the main pipe, heaps of broken stone are placed around these casings, covered by tarred-paper, and surmounted by the trumpet-mouthed collecting pipe, which communicates with a second line of escape-pipe, led off, like the other escape-pipes, at frequent intervals, to lamp-posts in the side-walks. It will be seen that for the larger pipes, two lines of the escape-pipes are provided in order to insure open passages to the air, for gas that may leak from the joints of the pipes, or from the joints of the casings surrounding the principal joints of the main pipes. The cast-iron pipes are made with a "bowl and spigot-joint," and are provided with a second bowl, outside of the ordinary bowl which is converted into a casing surrounding the ordinary lead joint of the first bowl, by the insertion of a ring around the pipe in the outer bowl, which leaves a cavity or chamber surrounding the lead joint; the outer portion of the second bowl being filled with a preparation of asphaltum, which is found to be better, cheaper and more convenient than lead for this purpose. The leaking gas is received into the chamber thus formed between the inner and outer joints and conducted away by be escape-pipes, after the manner of the other joints described. The leakage from the joint in the outer bowl is always provided for (as all external joints in this system), by surrounding it with a heap of broken stone covered with tarred-paper, from which an escape-pipe leads to a lamp-post in the side-walk, as before described. These heaps of stone also gather and discharge into escape-pipes any gas which may issue from an imperfection in the body of the pipe.

The delivery to houses of gas under such high pressure, as is carried in the main pipes, would be very dangerous; and two methods have been employed for lessening the pressure of the gas in the houses—one by the ordinary tank system, in which one tank governs the pressure carried in a large extent of low pressure lines in the streets and in the houses; the other, which has been adopted by the Philadelphia Company, makes use of a separate regulator for each dwelling or consumer; these regulators being so arranged that they will reduce the pressure in the house or service line, which supplies the fires, to not exceeding that of a column of about four inches of water. They are so contrived that, in case an interruption occurs in the supply from the main line, a valve closes, which will not open again, so long as a cock or any other opening exists in the house lines; thus affording a great security against a neglect to close the cocks at the fires in case of an interruption of the supply, and serving as a detector of bad fittings in the house line. The system of supplying consumers through the individual regulator has many features to recommend it over the method of supplying by tanks; a large number of consumers being always dependent upon the working of a tank, whereas only one consumer depends upon the working of a regulator.

A brief account of the principal features of the Philadelphia Company's system of mains is necessary to complete a view of the most advanced engineering in the transportation of fuel gas. The Company derives its supply from three sources. At Tarentum it has eleven wells; at Murrysville and Lyon's Run, fifty-four. During the year, the wells have been *shut in*, as it is called, by suspending to the casing of each a platform loaded with stone and earth, of a sufficient weight to overcome the pressure in the wells, which amounts to about five hundred pounds per square inch. The gas therefore is no longer allowed to be wasted by blowing off into the air, when not required by consumers; but is retained in the natural reservoir. It was found necessary to provide cast-steel fittings at the top of the wells; the ordinary cast-iron fittings not being strong enough to resist the interior strain.

There are thirteen lines of pipes belonging to the Philadelphia Co. reaching the City of Pittsburg, the lengths of these varying from seventeen to twenty-four miles from the wells to the City Hall. These several lines are inter-connected by cross-lines at several points throughout their length, and begin to ramify at the city limits, sending off large arteries to each part of the City; from which main arteries smaller ones distribute the fluid through all the considerable streets of the Cities of Pittsburg and Allegheny, and their suburbs. At the wells, the pipe connections are so arranged that the product of any well may be availed of to increase the pressure in any one of the several lines, so that several wells may be shut off from any part of the system and their places sup-

plied by others, securing any required pressure, upon any line, at all times. It is believed that this Company was the first to adopt the telescopic arrangement for pipes, increasing them in diameter at intervals on the way to the place of consumption, so as to be able to deliver a volume of gas at a designated pressure. The usual mode of laying gas mains has been to lay a pipe of uniform dimensions, no matter how long the line, submitting to a loss in both volume and pressure, according to the law of decrease in a uniform tube. In designing the Philadelphia Company's system, care was taken to avoid all dead-ends, and to provide frequent connections between all the main arteries of the system, so that the gas could be carried around in many circuits; and when it becomes necessary to shut off any portion of a main, only the smallest number of consumers will be affected thereby; indeed almost any repairs or changes may be made upon these lines without interrupting any consumer; for, if the gas cannot reach him from one direction, it will reach him from the other. The main lines are provided at their intersections with convenient stations, supplied with gauges attached to each of the lines; with governing valves, and with automatic safety valves, so that the pressures cannot accumulate above a certain tension. There are twenty-one of these stations, at which agents are in attendance night and day, and control the pressures in each section of the pipes according to the directions communicated by telephone from the office of the General Superintendent; the variations in the consumption on the different lines, making changes necessary from hour to hour, or sometimes as often as every quarter of an hour. Of course, the automatic safety valves provide against any dangerous accumulation of pressure; but it is desirable not to waste the gas, and to maintain a proper flow in the pipes in accordance with the consumption at the moment. It is expected to provide automatic regulators for this purpose; but at present, human agency is employed, as has been said.

It will have been seen from the foregoing, that the same concern for the protection of human life and for safety from accident, which led Mr. Westinghouse to the invention of the air-brake, has characterised his engineering in the construction of the great system of the Philadelphia Company, which has been so imperfectly sketched. To the writer, his early association with the foremost Company for the transportation of this new and dangerous gas seems a fortunate conjunction, for the people among whom he dwells—which may be called providential.

The bibliography of Natural gas is more extensive than is generally supposed, because the papers are scattered through the proceedings of many societies and through the volumes of geological surveys. The most important papers, because the authors are the most familiar with the subject, are those by Professors Lesley, Ashburner, Carll and White, in the geological surveys of Pennsylvania.

Mr. Ashburner has written several other papers on the geologic distribution of Natural gas, and the oil fields, which form a part of the same subject, printed by the American Institute of Mining Engineers. Mr. McMillan, President of the Ohio Institute of Mining Engineers; Mr. Edward Orton, State Geologist of Ohio; Mr. W. P. Shinn; Mr. Jos. D. Weeks, of the *American Manufacturer and Iron World*, of Pittsburg, Pa.; Mr. Lemuel Bannister, in a valuable pamphlet entitled "Something About Natural Gas;" Mr. Lorin Blodgett, in *Bradstreet's*; Mr. S. A. Ford, of Pittsburg, and Mr. F W. Taylor, in proceedings of the American Society of Mechanical Engineers.

Prof. Newberry, of the school of Mines, and Mr. T. Sterry Hunt, of the Canadian Geological Survey, were among the earliest investigators of the origin of oil and gas.

There is much else which might be referred to, but these references will open up the subject to those who wish to pursue the inquiry in a serious manner.—*The Railroad and Engineering Journal.*

CONSTRUCTION NEWS.

Water.

Mansfield, Mass.—Water-works are contemplated.

Water Rates.—Mr. Looney, of Portland, Me., has introduced a bill into the State Legislature providing for the regulation of water rates.

Islip and Bayshore, L. I.—Water-works are to be put in by Messrs. Moffett, Hodgkins & Clark, of Watertown, N. Y. The work is to be completed in two years.

New Brunswick, N. J.—There are now in use 24 miles of pipe, 173 hydrants and 265 stop gates. The consumption of water for 1886 was 397,143,873 gallons, a daily average of 1,088,065 gallons.

Salem, O.—Ten miles of pipe are required and bids will be received till March 1. The present supply, which is quite inadequate, is obtained from springs; the new supply will probably be obtained from wells.

Waterville, N. Y.—It is proposed to establish water-works this season. The works will be on the gravity system, will be owned by the village and cost about $50,000. Mr. E. D. SMALLEY, of Canastota, will make the survey shortly.

Decatur, Ala.—Col. GEORGE E. WARING has been in the city making investigations for a proposed system of drainage and water-works. He has also been engaged to make similar investigations for the suburban towns of Nashville, Tenn.

Wyckoff Pipe.—The Wyckoff Pipe Co., of Williamsport, Pa., has in the office a piece of wooden water pipe, 4-in. bore, which was dug up in Philadelphia last October and which was laid, according to the city records, in 1816. It is as sound now as when laid.

Belleville, (Ill.) Water Co.—At the recent annual meeting the following officers were elected: President, R. N. HAZZARD, New York; Vice President, E. J. SNOW; Secretary, J. M. MAGUIRE; Treasurer, M. T. STORKEY; H. C. COMEGYS. The works are in a prosperous condition.

Sewage Utilization.—A proposal has been made to the Board of Works, Jersey City, N. J., by MR. ANDERSON PRICE, of New York, to conduct the sewage of Passaic and Paterson along the river bank to a sewage farm below Newark, thus effecting an improvement in the water supply.

Rockford, Ill.—During the summer of 1886 a complete house to house inspection was made under the supervision of Dr. E. E. ODER, the city health officer. The report, which has recently been sent to the State Board of Health, included the materials of buildings, condition of cellars, ventilation, sewerage and drainage, water supply, and a considerable amount of other information.

Legislation on Water Supply.—The State Committee on Water Supply will give a hearing March 9, at 10.30 A. M., at the State House, Boston, Mass., to parties interested in providing by law for the formation of water supply corporations, for the establishment of a Board of Water Commissioners and for the purchase by cities and towns of franchises held by companies.

Paola, (Kan.) Water Co.—The following officers for 1887 have been elected: President, R. N. HAZZARD, New York; Vice President, E. J. SNOW; Secretary and Treasurer, J. M. MAGUIRE; Directors, J. E. LEWIS and T. L. WATSON. The company is in a thriving condition.

Creston, Ia.—A franchise for water-works has been granted to James Gamble, 68 Wall street, New York City.

The South Mt. Water Co.—Prof. J. W. MALLET, of the University of Virginia, on Feb. 18, addressed the Water Committee of the Philadelphia Council in support of the project of the South Mt. Water Co. to obtain upper Delaware water. He pointed out the present bad condition of Schuylkill water, the impossibility of protecting it and the inadequacy of its flow for the demands of a future Philadelphia water supply.

Chicago, Ill.—The water supply was very foul about February 12 owing to the sewage from the river being directed by the wind to the inlet crib. Samples of the polluted water were taken for analysis and showed a serious state of pollution. A change in the wind prevented the main body of the polluted water from reaching the crib. The Health Commissioner, Mr. DE WOLF, recommended that consumers boil the water before using.

Lynn, Mass.—The Water Board has recently submitted its 15th annual report. During the past year 18,494 feet of pipe were laid; 48 hydrants, 442 services, and 39 meters put in, besides a large number of repairs and replacements. Increased storage is stated to be required. The report contains much interesting information relative to the water supply, the cost and financial position of the works and their present condition. DANIEL WALDEN, Superintendent.

Stoughton, Mass.—The water-works were commenced in 1886 and are still in process of construction though water is being delivered. The water is taken from a well and pumped by steam to a stand-pipe 60 ft. high and 30 ft. in diameter. As yet there are only two hydrants and two meters. The main pipes are of cast-iron and the service pipes of iron and lead. Principal owner, J.G. PHINNEY. Superintendent, A. HAMILTON, JR.

Water Companies.—The Vicksburg Water Supply Co. has been incorporated to build water-works at Vicksburg, Miss. The incorporators are SAMUEL B. BULLOCK & Co., of New York City; E. S. BUTTS, CHARLES DELAFIELD and others. Capital stock, $250,000.

The Syracuse Water Works & Irrigation Co. has been incorporated by A. PRATT, C. D. PLATT, and L. P. WORDEN, of Syracuse, Kan., with a capital stock of $10,000.

The Nebraska City Water Co. has been incorporated to build water-works at Nebraska City, Neb. ROWLAND N. HAZZARD, of New York City, and H. N. SHEWELL, of Nebraska City, are interested. Construction will be commenced soon.

Texarkana, Ark.—Mr. C. L. SAMPSON, Secretary of the Texarkana Water Co., writes us that the water supply is more than sufficient for many years to come. The supply is obtained from a system of ten wells sunk 40 ft. into a bed of coarse gravel; they are flowing wells and the water is very pure. The wells were put down by the patent steam excavating process of J. A. Wagner Middletown, O.

The Deacon Waste-Water Meter patent being about to expire, the inventor, Mr. G. F. Deacon, water engineer of Liverpool, applied lately to the English Privy Council for an extension. In the course of the hearing it was shown that Mr. Deacon had so far received about $25,000 from his patent. In consideration of "its great merit and public utility," the Attorney General recommended that the letters patent be extended for three years more.

Jamestown, N. Y.—The city petitioned the governor to have the water supply examined, and at his direction the State Board made an examination and reported it unfit for use. The governor ordered the supply cut off, when the water-works company of Jamestown obtained an injunction against the governor, and a writ of *certiorari* to examine the proceedings of the State Board. The question now before Judge Daniels, at Buffalo, is whether Governor Hill can be enjoined in such a case, and whether the proceedings of the State Board of Health can be reviewed in the courts.—Syracuse (N. Y.) *Standard.*

Bridgewater, Mass.—It is expected that Mudge & Co., of Boston, will be granted the charter by the Legislature for establishing a water supply to Bridgewater and East Bridgewater, the town has voted not to oppose the application. The plan comprises a stand-pipe 75 feet high on the hill between the towns, a pumping engine of 2,000,000 gallons daily capacity, and from 8 to 12 miles of pipe, the company agreeing to lay pipe in every side street (after the important streets are piped) that will guarantee a small per cent. on the cost of laying the pipe. The works will cost about $100,000, and are to be built at the expense of the company, but citizens can purchase stock. Each town is to take 30 hydrants at $30 each, and $20 each if more than 50 are put in: water to be supplied free for street sprinkling, drinking fountains, and public buildings. The works are to be completed within the year.

New Water-Works.—Sterling, Kan. There will be a stand-pipe and four miles of mains; cost about $40,000.——Oakland, Cal. It is proposed to buy the Contra Costa water-works.——Niles, Neb. The works which were recently sold by the sheriff were purchased by Omaha parties.——Bath, N. Y. The Greenbush Water Co. offered to establish a water supply for $1,500 for five years; the village refused to give more than $1,000 and the negotiations were closed.——McKeesport, Pa. A new pump is to be put in.——Franklin, O. The works will be built soon, the judge having refused the injunction to restrain the trustees from constructing them——Concord, N. H. The water-works will be extended to East Concord, 12 and 6-in. pipes will be laid and eight hydrants.—— Coney Island, N. Y. A water supply for fire protection is proposed, salt water to be used.——Stockton, Kan. Water bonds for $30,000 have been voted.——Hasting, Neb. A partial test has been made with satisfactory results, the final test will be on the completion of the works in June.——Eldora, Tex. The mains are to be extended 1.35 miles.——San Francisco, Cal. The Spring Valley Water Co. will make considerable extensions.——Lachine, Canada. A direct pumping system is proposed; to be voted on at the end of March. Clyde, Kan. Water bonds for $10,000 voted to complete the works.——Greeley, Col. Pumping engines are to be put in.——Jackson, Tenn. It is proposed to issue $100,000 for water-works and sewerage.——Jefferson City, Mo. A company has proposed to put in water-works.——Azusa, Cal. The water company will draw a supply from the San Gabriel river by a tunnel.

The following places are to have water-works: Kissimmee, Fla. Address S. R. BASSETT.——Park Ridge, Ill. Pipe and hydrants ordered; A. L. BATES and C. H. PENNY.——Montgomery, Ala. Highland Park Improvement Co.——Janesville, Wis. Address HON. JOHN O. SPENCER.——Calera, Ala. Address the Calera Land Co.——Fernandina, Fla. Address, Dr. CLOUD.——Hastings, N. Y.——Pecos City, Tex.——Hammond, Ill.——Ridgewood, N. J.——Hartland, Kan.——Morrison, O.——Rushville, Neb.——Kyle, Tex.——Glenwood Springs, Col.——Appleton City, Mo.——Dixon, Cal.——Kenton, O.——York, Neb.——Live Oak, Fla.——Kearny, N. J.

Newport, O.—The Board of Water-Works Trustees held their annual meeting recently. During the past year 2,974 feet of mains have been distributed, and 201 service branches put in, making a total service connection of 3,023. It is recommended that owners of troughs be compelled to put in automatic valves, to prevent waste. The works are reported to be in good condition; the repairs have cost over $4,000 and the unskillful manner in which the engines were handled at the time nearly caused a water famine. A small expenditure would secure a flood proof engine, if the

water did not rise above 68 feet, while at present neither engine can be safely operated in 53 feet of water. The fuel saver experimented with is reported to be a complete failure.

Madison, Wis.—The Board of Water Commissioners has issued its report for the year ending October 1, 1886. The works are in good condition, the smaller engine is run for six days in the week and the larger one on the seventh, the boilers are changed every third week. The sixth well, finished in January, 1886, brings the daily supply up to 1,700,000 gallons. The report deals with the trouble caused by water waste. The population is between 12,000 and 13,000. The pumping machinery consists of two high pressure, Reynolds-Corlis engines, with Knowles pumps combined, they have capacities of 1,500,000 and 2,500,000 gallons. The supply is drawn from six artesian wells, and the direct pressure system is employed. The total amount pumped during the year was 236,649,850 gallons. During the year 12,297 feet of 3, 4 and 6-in. mains were laid, 14 hydrants and 22 valves; there are now 18.25 miles of pipe, 108 hydrants and 110 valves. The report contains a table giving particulars of water-works in towns of about the same population. JOHN B. HEIM is Superintendent.

Williamsport, Pa.—There has been considerable trouble between the two consolidated water companies and the citizens over a proposition for the establishment of city water-works, and there has been considerable discussion over the rates and the quality of the supply. In November, 1886, Mr. W. R. COATS, sanitary engineer, made a report recommending a public water supply. The city is situated on the west branch of the Susquehanna river, and has a population of about 30,000. The companies have supplied water for 30 years, the supply being drawn from two streams rising from mountain springs about three or four miles distant, and piped to the city through 16-inch mains; the water shed is about 50 square miles. As an additional supply was imperatively necessary arrangements were made for the construction of a large storage reservoir in Mosquito valley, but the public health officer stated that the quality of the supply was bad and the whole question was put to public vote. On February 15, the vote was for new works by a majority of 150, but it is stated that a new city council was elected that was opposed to new works. The company will probably sink a well near the river and pump direct to reinforce the supply.

Braintree, Mass.—The committee appointed to negotiate with the Braintree Water Supply Co. for the purchase of its franchise and plant has received a communication from F. A. HOBART, President of the company, referring to the contract entered into in October last. This contract provides for a filter gallery 100 ft. by 15 ft. and 16 ft. deep, with stone walls, brick arch, brick pump well and all appurtenances, to be built near South Braintree; a brick pumping station; two pumping engines of 1,000,000 and 750,000 gallons daily capacity, with boilers and all fittings; a boiler iron or steel stand-pipe 30 ft. in diameter to give a static head of 150 ft.; a complete system of not less than 12 miles of cast-iron supply and distributing mains, from 4 to 12 ins. diameter, with all hydrants, valves, etc.; all service pipes and other work; to have the works complete by October, 1887. The contractors have constructed the filter gallery, purchased the pipe and hydrants and prepared plans for the buildings and pipe system. The estimated cost under the contract is $129,000, the net cost of the works to the town would be about $150,000, exclusive of land and water rights. The company now makes a proposition to sell to the town its franchise, rights and privileges for $23,000, the town to assume and pay all obligations under the contract, all damages and all construction expenses incurred.

Buffalo, N. Y.—The Water Commissioners have reported that the extensions of the mains and the increased consumption is taxing the pumping capacity severely during the cold weather and recommend that immediate steps be taken to provide additional pumping machinery and other works necessary to insure a full supply in the future. The report states that there is undue waste, consumers being under the impression that with Lake Erie to draw from the water waste is of no consequence. It is therefore recommended that the Commissioners be authorized to advertise for proposals for an additional pumping engine with a daily capacity of 20,000,000 gallons, with boilers, etc., complete.

During the present year 18 miles of mains, 20, 16, 12 and 10 inches diameter, will be laid, 12 miles of 6-inch and one mile of 4-inch distributing pipe; a bridge will be built across the Main and Hamburg canal to carry a 10 inch pipe. The cost of the work is estimated at $15,000. In addition to this the 4 feet shaft in the inlet pier will be enlarged to 6 feet diameter, the full size of the tunnel; new wells and conduits will be blasted out, new gate placed in well and other necessary work done on inlet and Bird island piers; a new boiler house will be erected and the present one improved, and a line of 36-inch pipe will be laid from the engine house up the hill. This work is estimated to cost $25,000. It is recommended that the Commissioners be authorized to advertise for proposals.

Helena, Mont.—A decision has been rendered in the water-works case, in which certain citizens as plaintiffs brought suit against the mayor and councils to restrain them from laying water pipe. The city council granted to GEO. F. WOOLSTON a franchise or charter to lay water pipes in the city, and contracted with him for 150 hydrants at $100 each per year for twenty years and to rent additional hydrants at $65 each in proportion to the amount of pipe laid after the first thirteen miles. The council further stipulated that it would receive water for city use from no other company for the period of twenty years. Thereupon the plaintiffs obtained an injunction; WOOLSTON left the place and practically dropped from the suit. Defendants moved for a dissolution of the injunction, and on the motion being denied carried an appeal to the Supreme Court. The final decision recently rendered upholds the injunction.

The right of the plaintiff to move for the injunction and the right of the city council to grant to private persons or companies the privilege of laying pipes in the streets are both admitted. The court says it is clearly beyond the power of the city council to create a monopoly, that power reposing only in a soverign legislature, which a city council is not. Whether the ordinance creates a monopoly is then discussed and the opinion expressed that the contract giving to WOOLSTON the exclusive right to furnish all water chargeable to the city for a period of twenty years is a monopoly. If not a monopoly, the court says, it is difficult to conceive of one. Such a contract for a period of twenty years is pronounced so long as to be considered unreasonable. The city has also exceeded the limits of its charter in its indebtedness under the contract. The court is still more pronounced and explicit on the point involving the chartered duty of the city to advertise for bids on all contracts involving an expenditure of more than $100. There was nothing to prevent a call for bids and it is clearly made the duty of the council by the charter from which it derives its powers to call for such bids before entering into this contract, which involves the expenditure of about $125 for every three days for a period of twenty years. The opinion of the court is that the territorial legislative restriction act does not cover this in a prohibitory way.

A Chance for Sewerage Engineers.—Now, here is a straigh tout, honest statement to begin with: Birmingham (Ala.) is not a safe place to live in. "Birmingham is situated in a valley undulatory and naturally drained." That is what the prospectus says. Well, there is no artificial drainage, that is sure. And if the lack of sewers, the absence even of rude gutters to dispose of slops and filth, the utter carelessness of every sanitary need — if this means "natural drainage," then natural drainage is just what Birmingham has and has abundantly. There is no river big or small, no water course here at all. Simply described, Birmingham town is just one flat stretch of soil hemmed in by mountain sides suddenly rising from her limits. The mountains drain on Birmingham; Birmingham drains on herself. Were there even an insignificant creek at hand sanitary necessities could be readily afforded. As natural conditions do exist in this flat territory anything akin to a satisfactory sewerage system will require the expenditure of immense sums of money. One or two puny, cheap, and abortive schemes have failed. Birmingham so far has been too much on the rush, too much given over to booming, to think or care apparently for trivial things like this of making her homes habitable.

The result is that to-day when an observer goes through the streets he is largely oblivous to everything save that he has a nose. Pools of green and slimy water, nastiness trickling from back yard to back yard, hogs running loose in every part of the town, (all unsuspicious that they are not in a fit and appropriate sty), streets are only stretches of miry clay, unsafe for light wagons, unfit for heavy ones — stench, stench, stench! on the ground, in the air—stench everywhere, stench eternal! Thirty thousand people massed in one topsy-turvy community; 30,230 people with no running water within miles, with no sewerage system, with a soil soaked till it is flabby with filth, nastiness accumulated and accumulating in very lakes. This means and can mean but one thing; and that one thing is that Birmingham bids defiance to the sternest of all natural laws, courts disease, tempts epidemic. The cholera that nipped the first years of her existence, when but 2,000 or 3,000 people were here, taught its terrible lesson in vain. Men fell by scores in her very streets then, unwarned of their danger, but with all that deadly experience there is no more security against the same epidemic now than there was then, nor so much; for where there was a little community at that time there is at present a driving city of 30,000 souls. Men overtaxed by excitement and wearied by trying schemes of money making crowd here now, sensitive to disease, almost nervously prostrate the half of them.—*Correspondence N. Y. Times.*

Railroads Bridges and Canals.

Canada Atlantic R. R.—It is proposed to extend the road from Renfrew by way of Eganville, up the Bonnechere valley near Opeonge lake to Georgian bay.

Missouri Pacific R. R.—Work on the Paola branch is stopped, owing to a dispute in regard to the right of way which interests Mr. MCCRACKEN, the contractor, to the amount of nearly $50,000.

Egyptian Railroads.—The Egyptian Railroad Administration will submit a proposal to the Council of Ministers for the issue of a loan to meet the cost of proposed extensions of the railroad system.

Dredge Burnt.—The dredge boat engaged on the construction of the drainage canal in Piatt county, Ill., was destroyed by fire recently; a can of oil set on the stove to warm, being upset. The loss is estimated at $19,000.

Louisville & Nashville R. R.—Work on the Cumberland Valley branch is being pushed as rapidly as possible, but owing to the high water the bridge and culvert masonry is a little behind. From Corbin three miles are ready for the ties; seven miles from that town will be a tunnel 600 feet long which will not be completed for five months. Engineers are at work on surveys for a line into Virginia.

A Great Narrow-Gauge System.—A project is on foot to connect the several narrow gauge systems in the west and consolidate them into one great system. The lines interested are the Mexican National R. R., the South Pacific Coast R. R., the Denver & Rio Grande R. R., and the Texas, Santa Fé & Northern R. R. The following lines are proposed to complete the system: an extension of the Texas, Santa Fé & Northern R. R. south to El Paso to connect with the Mexican National R. R., which will be built north from Laredo to that place, also a line from the Denver & Rio Grande R. R. at the Green river, in Utah, to Santa Cruz, Cal., where it would connect with the South Pacific Coast R. R. which runs to San Francisco; this road would be 800 miles long. W. J. PALMER, President of the Mexican National R. R., is at the head of this project and is in England now raising the funds for the extensions.

Railroad Surveys.—Duluth, Red Wing & Southern R. R. A survey has been made from Owatonna to Kenyon.——Vincennes & New Albany R. R. Chief engineer N. P. HOBART will make the survey to New Albany, Ind.——Chicago, Milwaukee & St Paul R. R. A survey is being made from the Tomahawk river, Wis., to Hurley and Ashland.——Louisville Southern. The survey is completed and work will be commenced in March.——Chicago, Burlington & Northern R. R. A party in charge of CAPT. ELDRIDGE, has reached St. Croix Falls, Minn., and will continue the line to Prescott.——St. Louis, Kansas City & Colorado R. R. Chief Engineer EMERSON has completed the survey from Versailles to Sedalia, Mo., and will soon reach Sibley.——St. Louis & San Francisco R. R. Engineers Craig and Van Zandt have started from Salem, Mo., to locate the extension southwest to the Memphis, Springfield & Kansas City R. R.——Pennsylvania R. R. A survey has been made for a line 28 miles long from Peters creek, on Pittsburg, Virginia & Charleston R. R., to McDonalds station on the Panhandle line.——Current River R. R. A survey is being made from Willow Springs to Cairo, Ill.——Union Pacific R. R. The engineers have surveyed the line from Iuka to Sterling, Kan., and are pushing on to McPherson.——Pittsburg, Painesville & Fairport, R. R. A survey has been made for a branch from Middlefield, O., to Windsor, eight miles.——Orleans, French Lick & Paoli R. R. A survey has been made from French Lick, Ind., to Birdseye.——L. P. EVERETT has surveyed a line from Woodland, Cal., up Cache creek cañon

Mexican Railroads.—The Texas Mexican R. R. will be sold at Galveston, Tex., on March 1 by the county sheriff, as a result of a suit brought against the railroad company and the Guarantee Safe Trust Deposit Co., by the National Construction Co.; the judgment is for $180,194. The sale will include the roadbed, franchise, etc., from Galveston to Lafitte Grove, about 20 miles, and the rights of way and interest conferred by the city of Galveston.

Articles of incorporation have been filed with the Secretary of State of Colorado for the construction of the Colorado extension of the Mexican National R. R. The reorganization of the company has been effected within the terms of the first mortgage and deed of trust made April, 1881, to A. H. GREEN and L. H. MEYER, trustees. Under this reorganization it is intended to construct a considerable portion of the main line. The total length of the company's lines will be about 700 miles, of which 318 are constructed. The directors are WILLIAM M. SPACKMAN, WILLIAM W. NEVIN, and others. The Colorado office will be at Colorado Springs, Col., and the general offices are at New York and the City of Mexico.

New Railroad Companies.—Central Mexico R. R. Co. L. C. Wade, Newton, Mass., Foster Nichols, Pueblo, Col., and others; capital stock, $1,000,000.——Holton, Council Grove & Southwestern R. R. Co. F. H. Crosby, New York City, C. W. Adair, Strong City, Kan., and others; capital stock, $1,000,000; from Holton, Kan., to the southern state line.——Hillsboro Branch R. R. Co. Thomas Shea, Hillsboro, Wis., and others; capital stock, $1,500,000; from Hillsboro, Wis., to New Lisbon and a point on the Chicago & Northwestern R. R.——Nebraska & Western R. R. Co. O. J. Hollister, M. M. Kaighn, and others; capital stock, $6,000,000; from Covington, Neb., to the western State line.——Florence & Chicago R. R. Co. W. B. Wood, W. C. Sherrod, of Florence, Ala., and others; capital stock, $500,000; from Florence, Ala., to Waynesboro, Tenn.——Chicago, Peoria & St. Louis R. R. Co. Charles S. Rannels, Marcus Hook, and others, of Jacksonville, Ill., capital stock, $2,000,000; from Pekin to Jacksonville with a branch from Havanna to Springfield.——Duluth, St Cloud, Mankato & Southern R. R. Co.; capital stock $6,000,000.——Virginia Western R. R. Co. President, A. S. Buford, Natural Bridge, Va.——Tennessee Midland R. R. Co. O. S. Buford, W. D. Bethell, Memphis, Tenn., and others.——Little Rock & Eastern R. R., S. W. Fordyce, J. W. Phillips, St. Louis, Mo., and others; capital stock, $650,000; from Little Rock to Altheimer on the St. Louis, Arkansas & Texas R. R. 50 miles.——Arkansas & Southern R. R. Co. S. W. Fordyce, J. W. Phillips, St. Louis, Mo., and others; capital stock, $750,000; from Lewisville to Shreveport, La., on the St. Louis, Arkansas & Texas R. R. Fort Smith & El Paso R. R. Co. James Brizolara, W. M. Fishback, Fort Smith Ark., and others; capital stock, $7,000; from Fort Smith to the State line, ¾ mile.

Proposals Open.

Masonry.—First-class bridge masonry, 900 cu. yds., on the Springfield extension of the L. & N. R. R. DONALDSON & ROLLINS, contractors, Bardstown, Ky.

Laying Water Mains.—BOARD OF PUBLIC WORKS, Nashville, Tenn.

Sewers and Bridge Work.—Branch sewers and work at Market street bridge. SAMUEL L. SMEDLEY, Department of Surveys, Philadelphia, Pa. March 1.

Fuel Boat.—For dredge on Great Kanawha river. Lieut. Col. WM. P. CRAIGHILL, U. S. Engineer Office, Charleston, W. Va. March 1.

Paving.—Sheet and block asphalt, stone, wood and macadam. J. E. HOUSE, Chairman, Board of Public Works, Omaha, Neb. March 1.

Railroad Work—From Cerulean Springs, Ky., to Princeton; clearing and grubbing 3 miles; rock cut, 16,000 cu. yds.; earth, 110,000; bank, 160,000; masonry, 1,000; trestle, 400,000 ft. B. M.; cross ties, 50,000. B. L. COBB, Chief Engineer, Indiana, Alabama & Texas R. R., Clarksville, Tenn. March 1.

Pier Work.—New pier and repairs. DEPARTMENT OF DOCKS, New York City. March 2.

Sewers.—18 and 16 in. brick; 12 and 15-in. pipe; 18 and 20-in. iron pipe; iron bridge over railroad. CHARLES E. CARPENTER, Board of Public Works, Providence, R. I. March 2.

Approaches.—Excavating, curbing, paving, etc., for approaches to court house at Columbus, O. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C. March 3.

Curbing and Crosswalks.—CHARLES E. CARPENTER, Board of Public Works, Providence, R. I. March 4.

Street Work.—Grading, curbing and paving. A. E. SMYRK, City Commissioner, Baltimore, Md. March 5.

Masonry.—Reservoir outlet and wing walls. Lieut. Col. PETER C. HAINS, U. S. Engineer Office, Washington, D. C. March 7.

Flagging, Curbing and Sewers.—The COMMISSIONER OF PUBLIC WORKS, New York City. March 7.

Hydrants, Pipe, Etc.—The COMMISSIONER OF PUBLIC WORKS, New York City. March 7.

Street Work.—Grading, piling, flagging, curbing and granite paving. THOMAS J. LANAHAN, Clerk, Board of Contract and Apportionment, Albany, N. Y. March 7.

Warehouse.—At Ottawa, extension of time. A. GOBEIL, Secretary, Department of Public Works, Ottawa, Canada. March 7.

Water-Works.—Complete system, direct pressure. E. A. STURGIS, Mayor, Waco, Tex. March 10.

Earth Filling—At Washington monument. Col. THOS. LINCOLN CASEY, Engineer Office, Washington Monument, Washington, D. C. March 10.

Street Lighting.—WM. F. KING, Clerk, Town Council, Johnson, R. I. March 12.

Paving.—Granite or other material, except wood: 25,000 square yards. JOHN G. FLETCHER, President, Improvement Board, Little Rock, Ark. March 13.

Steam Heating Apparatus.—For custom house at Mobile, Ala. M. E. BELL, Supervising Architect, Treasury Department, Washington, D. C. March 14.

Elevator.—Hydraulic passenger elevator for same building. M. E. BELL (as above). March 14.

Sewers.—Brick, 6, 4 and 2¼ ft. diameter. JOHN W. FLETEMEYER, City Clerk, Lafayette, Ind. March 14.

Tunnel and Approaches.—Under Washington street. THOMAS JACOB, Clerk, Board of Public Works, Jersey City, N. J. March 14.

Levee.—Strengthening Sny island levee. CAPT. E. H. RUFFNER, U. S. Engineer Office, Quincy, Ill. March 15.

Court House.—For Freeborn county, Minn., C. O. BARNES, County Auditor, Albert Lea, Minn. March 15.

Electric Light Plant.—For 1728 incandescent and 30 arc lights. Z. P. BROCKWAY, General Superintendent, Elmira, N. Y. March 15.

Court House.—Two story brick building; cost not to exceed $21,000. R. C. WEIGHTMANN, Clerk of Police Jury, Tallulah, La. March 16.

Water Works.—A supply for 50 hydrants; to throw a 100 feet stream for at least two hours. The contract to cover a term of years and the contractor to own and operate the works. J. W. GULICK, Mayor, Goldsboro, N. C. March 21.

Street Work—Grading, curbing, paving, macadam, culverts, drains, etc. THOMAS G. SMITH, President, Board of Public Affairs, Cincinnati, O. March 23.

Sewerage System.—Plans and specifications at office of the city engineer. R. C. LIGHTBODY, Mayor, El Paso Tex. April 4.

Electric Lighting.—THE MAYOR, Muscatine, Ia April 15.

Contracting.

Water Works.—Quigley & Co., of Arkansas City, Ark., have been awarded the contract for the works at Kiowa, Kan.

Masonry.—The following proposal for coping and masonry has been received at Newport, Ky.: Frederick Gerine, Dayton, Ky., $2,337.

Furnaces.—Gordon, Strobel, Laureau & Co., of Philadelphia, have been awarded the contract for the erection of three coke burning, hot blast furnaces at Sheffield, Ala., for the Alabama & Tennessee Coal & Iron Co.

Sewers and Paving.—At St. Paul, Minn., the Board of Public Works has awarded contracts as follows: *Sewers*; William Preston, $954; Patrick Doherty, $10,582; Stockton & Lindquist, $12,800; White & Adams, $1,620. *Paving*, J. H. Fielding, $25,390; Warren-Scharf Asphalt Paving Co., $140,795.

Canadian Pacific R. R.—The contracts for the construction of the Algoma Branch extension to Sault Ste. Marie, Mich., have been awarded as follows: Anderson & Reid, 79 miles; Mackenzie & Rousseau, 5 miles; Corbet & Kemp (very heavy work) 2 miles. The contract for the clearing and timber work has been awarded to Carry & Dunn.

Pipe Foundry.—A pipe foundry is to be built at Anniston, Ala., with a daily capacity of 200 tons. The stock is all subscribed and paid in.

New Croton Aqueduct.—The contract for the construction of the gate-house at 135th street, N. Y. City, has been awarded to Richard A. Malone.

Water Pipe, Hydrants, Etc.—The Michigan Pipe Co., of Bay City, Mich., has secured through S. V. Saleno, its representative at Denver, Col., the contract for 49,000 ft. of Wyckoff water pipe, with hydrants, valves specials and laying. The contract price is $34,000 and work is to be completed by June.

Sewer Brick.—At Minneapolis, Minn., the following bids have been received for between 4,000,000 and 5,000,000 brick: C. J. Swanson, $10 per 1,000 for the first 500,000; $9.50 per 1,000 above that number. Wisconsin Red Pressed Brick Co., $9.25. Gregg & Griswold, $10 for the first 500,000; $9.50 above that number. Louis Frederick, $11.

Depot.—The plans for the new west end depot of the Atlantic & Northwestern R. R. at Montreal have been deposited with the Clerk of the Peace. It will be reached by an elevated railroad, thus avoiding all obstruction to traffic by level crossings.

Heating Apparatus.—The following proposals for steam heating apparatus have been received by the Water Board, Boston, Mass.: Walworth Manufacturing Co., $4,397; A. B. Franklin, $4,442; Ingalls & Kendricken, $4,485; A. A. Sanborn, $5,085. The contract has been awarded to the Walworth Manufacturing Co.

Rolling Stock.—The Pullman Car Co. has been awarded the contract for the complete equipment for an express train service on the Atlantic Coast line.——The Michigan Car Co., Detroit Mich., is crowded with work and has recently declined to bid for 5,500 cars.——The South Baltimore Car Works Co., has been organized at Baltimore, Md., with a capital stock of $200,000, by Robert Garrett, T. Harrison Garrett and others.

Pump.—The following proposals for a portable 6-in. centrifugal pump have been received by the Water Board, Boston, Mass.: Cochnower, Perrin & Co., $1,925; Joseph Edwards & Co., of New York, (Andrews engine) $1,930, (Westinghouse engine) $2,150; John Post, Jr., & Co., $2,460.

The Sewerage of Mexico.—The San Francisco *Chronicle* is authority for saying that Messrs. CARPENTER & HUMPHREYS, late Cal. R. R. Commissioners, have secured the contract for the sewerage of the City of Mexico. The amount involved is set down as $8,000,000; a very rough guess in all probability; a sum quite beyond at least the immediate resources of the city interested.

Paving.—The Board of Contract and Apportionment, Albany, N. Y., has ordered the Broadway pavement to be advertised. This will be a work of considerable magnitude, calling for 30,000 sq. yds. of granite block pavement, 13,500 ft. of 5-in. curb and about 11,000 lin. ft. of new sidewalk. Specifications can be obtained from the Board, and profiles can be seen in the office of the City Engineer.

Wrought-Iron Pipe.—The following proposals have been received by the Water Board, Boston, Mass., for building and placing a wrought-iron water pipe on Chestnut hill avenue bridge, over the Boston & Albany R. R. at Brookline: Kendall & Roberts, $528; George Miles, $598; Robinson Boiler Co., $598; Joseph Russell & Son, $687; Atlantic Iron Works, $932. The contract was awarded to Kendall & Roberts.

Dredging.—The following proposals were opened February 23 by, Lieut. Col. WALTER MCFARLAND, U. S. Engineer Office, New York City, for dredging in New York harbor: Main Ship Channel, 2,000,000 cu. yds.; John E. Walsh, 24 cts. per cu. yd.——Gedney's Channel, 600,000 cu. yds.; Deep Sea Hydraulic Dredging Co., Wm. H. Beard, President, 34.75 cts. per cu. yd.; Alfred A. Howlett, 38.3 cts.; John E. Walsh, 43 cts.; Jos. Edwards, 47 cts. for 6,000 cu. yds. per month, 54 cts. for 100,000 cu. yds. per month, 43 cts. for the remainder; R. Moore, 51.3 cts. All the bids were rejected as too high, and it is uncertain whether the work will be readvertised, or whether the Government will undertake the work. Col. MCFARLAND thinks the Government could do it for 20 cts. per yd. after the plant is established.

Boilers.—The Water-Works Trustees, Hamilton, O., have received the following proposals for boilers, etc.: Ritchey, Dyer & Co., Hamilton, O., (boilers complete), $3,878; E. H. Brownell & Co., Dayton, O., $1,800; Erie City Iron Works, Erie, Pa., $1,960; Armstrong Bros. Springfield, O., $2,237.27; J. C. Walton, Louisville, Ky., $2,251.46; W. B. Pollock, Youngstown, O., $2,300; Brightman Stoker Co., Cleveland, O., $3,200. The contract was awarded to Ritchey, Dyer & Co., they being the lowest bidders for the boilers complete.

Harbor Improvement.—The following proposals were opened February 15, by Capt. D. W. LOCKWOOD, U. S. Engineer Office, Grand Rapids, Mich., for work at Charlevoix harbor: *Revetment*; Luther E. Allen, Charlevoix, Mich., $1,703.97; John Munroe, South Arm, Mich. $2,178.60; W. E. Hutchinson, Saugatuck, Mich., $2,193.13; Green Bay Dredging & Pile Driving Co., Green Bay, Wis., $2,288.49; Green's Dredging Co., Chicago, $2,938.70. *Dredging*; Luther E. Allen, $1,837; Green's Dredging Co., $1,870; C. E. Mitchell, $2,415; Green Bay Dredging Co., $1,667.50; R. Finch, $3,290. *Crib*; Luther E. Allen, $2,122.10; John Munroe, $2,277.23; Green Bay Dredging Co., $2,282.91; C. E. Mitchell, $2,316.86; Green's Dredging Co., $2,473.50; W. E. Hutchinson, $2,611.15.

Bridges.—Messrs. W. G. Coolidge & Co., of Chicago, Ill., have been awarded contracts for the following work: an iron lattice drawbridge, 290 ft. span, over the St. Croix river, on the Minneapolis, Sault Ste. Marie & Atlantic R. R.; an iron drawbridge at Marseilles, Ill., on the Chicago, Rock Island & Pacific R. R.; all the truss bridges on the Republic Branch R. R., and three spans on the Louisville, New Albany & Chicago R. R.

The Atlanta Bridge Works, of Atlanta, Ga., have been awarded the contract for the substructure and superstructure of the Flint river drawbridge on the Americus, Preston & Lumpkin R. R.; the span is 185 ft. the pivot pier has one cylinder 18 ft. in diameter and the end piers have two cylinders 4 ft. each in diameter.

River and Harbor Work.—Proposals were opened February 15, by CAPT. D. W. LOCKWOOD, U. S. Engineer Office, Grand Rapids, Mich., for improvements to rivers and harbors in Michigan. At Frankfort: C. E. Mitchell, Ludington, Mich., $6,402 11; Luther E. Allen, Charlevoix, Mich., $5,873.02.——At Portage Lake: Stephen Bedford, Manistee, Mich., $4,831.63; Luther E. Allen, $4,434.42; C. E. Mitchell, $5,018.19; Schwarz & Berner, Green Bay, Wis., $4,298.94.——At Manistee Stephen Bedford, $6,007.66; Henry M. Youmans, East Saginaw, Mich., $5,837.12; C. E. Mitchell, $5,603 32; Schwarz & Berner, $5,16 .39.——At Pentwater: C. E. Mitchell, $6,799.92.——At Muskegon: Henry M. Youmans, $5,837 12; C. E. Mitchell, $6,268.52; H. B. Kerr & Co., Chicago, $6,624.21; Wm. McMillan, Muskegon, $5,592.71; Schwarz & Berner, $5,251.45.——At South Haven: H. B. Kerr & Co., $7,433.23.

Harbor Work.—The following proposals were opened February 15, by Capt. D. W. LOCKWOOD, U. S. Engineer Office, Grand Rapids, Mich., for work at Grand Haven:—

	Piles.		Timber.				Iron.			Stone.	Brush.	Dredging.	Total.
	Foundation.	Sheet.	Oak.	Hemlock.	Pine.	Pine Plank.	Screw-Bolts.	Drift-Bolts.	Spikes.				
	Per lin. ft.	Per lin. ft.	Per M.	Per M.	Per M.	Per M.	Per pound.	Per pound.	Per pound.	Per cord	Per cord	Per cu. yd.	
	$	cts.	$	$	$	$	cts.	cts.	cts.	$	$	cts.	
Schwarz & Berner.....	0.93	24	42	22	27	25	5	3¾	5	9.25	4	38	$5,279.42
C. Sutherland.....	0.90	20	40	25	30	25	5	5	5	10.00	4	60	5,837.12
Robert Finch.....	0.95	25	35	24	27	22	7	5	5	11.50	4	50	6,039.16
Thomas W. Kirby.....	0.90	22	30	24	24	26	6	5	6	12.00	4	40	6,066.39
H. B. Kerr & Co.....	1.00	35	38	26	29	27	8	5	6	11.00	3	50	8,210.60

How County Contracts Should be Let.—The commissioners erred in the Browning bridge matter, in that they did not have the court appoint inspectors as the law required, and have them inspect the bridge after the contractor had completed the work, and report to the court. Then, their way of letting contracts while it is not illegal, is unsatisfactory to their constituents. The law does not require them to advertise a contract when they have one to let, yet they should do so, as it is economy in the end, and does away with the suspicion which always surrounds the secret letting of contracts.—Uniontown (Pa.) *Genius.*

Wooden Outlet Sewer.—Mr. Horace Loomis, Eng. of Sewers, New York City, is now building at Pier 29, East river an outlet sewer of creosoted yellow pine. The sewer is circular, 4 ft. in diameter and 541 ft. long. The staves are 4in. thick planed radially and are secured by galvanized iron hoops, 3x⅜in., tightened by two bolts passing through shoulders on the semi-hoops. The hoops are spaced about 4ft. apart, and the sections of the sewer but squarely and the joint is covered by a ¾x8in. hoops. This sewer is supported upon caps bolted to the piles of the wharf previously in place, and the joints of abutting sections are made to rest upon these caps.

Laying Water Mains, Etc.—At the Department of Public Works, New York City, the following proposals have been received: (1), Laying water mains; J Cornwell, Jr., $13,594; B. Mahon, $14,457; F. Thileman, Jr., $14,928; Borstmann & Cornwell, $15,090; M. J. Kane $15,891; W. H. Morton, $16,252; W. G. Horgan, informal; (2), Furnishing tapping cocks and hydrant waste cocks: Hotchkiss, Field & Co., $3,565; McNab & Harlan Co., $4,220; J. Jonson, $4,712.50; Mayor, Lane & Co., $5,762; John Fox, informal. (3), Coal (3,200 tons); Geo. W. Hurant, $15,968.

Railroad Contracts.—Rogers & Ballantyne, S. C Knowlton & Co., and Green & Brogan have been awarded contracts for raising the track of the New Orleans division of the Texas & Pacific R. R., from New Orleans to Shreveport. The roadbed is to be raised two feet, grading, ballasting and cross tieing to be done, bridges and culverts raised and steel rails laid over the entire length.

The Bailey Construction Co. has been awarded the contract for the construction of the South Atlantic & Ohio R. R. in Virginia to the Kentucky line, about 80 miles. The grading is done as far as Clinch River, 42 miles, and the bridges and masonry have been completed. The road will be in operation to Estillville, Va., by April and to Clinch River by June.

Charles A. Gatchell, of Buffalo, N. Y., is the contractor for the Gladwin extension of the Michigan Central R. R.; and McRae & Lalley have nearly completed their work on the Vanderbilt extension of the same line.

City Work.—At Louisville, Ky., the following contracts have been awarded: Broken stone, 90 cts. per cu. yd.; Gleason & Gosnell. Undressed flagging, 34 cts. per ft.; undressed block stone, $2.50 per cu. yd.; M. Gleason. Undressed curb, 36 cts. per ft.; undressed gutter flagging, 35 cts. per ft.; John Weissenstein. Bowlders, $4.44 per perch; F. M. Dougherty. Hardwood blocks for repairing Wyckoff pavement, swamp ash, $9 per cord; block locust, $20; red cedar, $18; Selvage & Henry. Iron, cast-iron, 2 cts. per lb; wrought-iron, 4 cts.; castings, 5 cts.; Grainger & Co. Louisville cement, $1.09 per barrel; Salem lime, 80 cts.; J. B. Speed & Co. Lumber, white oak, (for bridges) $22.50 per 1,000 ft. B. M., (for water ways), $21.50; pine, $16; Mehler & Eckster kemper. Sand, F. Zabel, 90 cts. per cu. yd. and Scott Newman, $1. Brick, (sidewalk) $8 per 1,000, (sewers and cisterns) $7.50; W. Berger. Stoneware pipe, (straight) 4, 5, 6, 8, 9, 10, 12, 15, 18, 21 and 24-in., 8, 10, 11, 14, 14, 22, 29, 38, 55, 70 cts. and $1.10 per ft.; (bends) 4, 5, 6, 8, 9, 10 and 12-in., 20, 25, 38, 55, 55, 75 cts. and $1 each; (curves) 12, 15 and 18-in., 30, 40 and 60 cts. per ft.; (slants) 4, 5, 6, 8, 9, 10, 12, 15 and 18-in., 5, 5, 10, 20, 25, 70, 70 cts., $1.25 and $1.75 each; (branches) 4, 5, 6, 8, 9, 10, 12, 15, 18, 21 and 24-inch, 16, 20, 22, 28, 28, 44, 58, 76, $1.10, $1.40 and $2.20 each; (traps) 8, 12, 15 and 18-in., $3; 10-in., $3.50.

Masonry.— The following proposals have been received at the office of the Supervising Architect, Treasury Department, Washington, D. C., for masonry for the court-house at Harrisburg, Va.: McCarthy & Corbett, $4,263; P. S. Thomas, $4,393.77; W. F. Billhimer, $6,000. For sidewalks, McCarthy & Corbett, $1,500; Buckley & Co., $1,979.80. The contract was awarded to the lowest bidder.

Iron Work.—The following proposals have been received at the office of the Supervising Architect, Treasury Department, Washington, D. C., for iron columns, etc., for the custom house at Richmond, Va.: Asa Snyder & Co., $5,765; Snead & Co. Iron Works, $5,895; Dearborn Foundry Co., $6,996; Marshall Foundry & Construction Co., $7,499.80; F. I. Meyers Manufacturing Co., $7,600. The contract was awarded to Asa Snyder & Co.

Pipe, Valves and Hydrants.—The following proposals for water pipe, specials, valves and hydrants have been received at Kalamazoo, Mich.: *Pipe*; Ohio Pipe Co., Columbus, O., 6, 8 and 10-in., $33 per ton of 2,000 pounds; specials, 3 cts. per pound: total, $11,683.85. Dennis Long & Co., Louisville, Ky., $35.97, $35.47, and $34.47 for 6, 8 and 10-in.: 2.98 cts. for specials; total, $12,-305.92. Mellert Foundry & Machine Co., Reading, Pa., $35 for all sizes, 3 cts., $12,351.96. R. D. Wood & Co. Philadelphia, Pa., $37.45, $37.45, $35.70, 3 cts., $12,762.99. Shickle, Harrison & Howard Iron Co., St. Louis, Mo., $38 for all sizes, 3 cts.; $13,354.13. Cincinnati & Newport Iron & Pipe Co., Newport, Ky., $38 for all sizes, 3½ cts., $13,464.13.

Water Gates.—James Flower & Bros., Detroit, Mich., 4-in., $7.85; 6-in., $12.20; 8-in., $18.35; 9-in., $26; total $548.55. Crane Bros. Manufacturing Co., Chicago, (Peet); $8, $12, $20, $26, $554. Whittier Machine Co., Boston, Mass.; $8, $12, $25, $20, $36.40, $360.40. Eddy Valve Co., Waterford, N. Y.; $8, $13.90, $20, $27, $580.90. I. S. Cassin & Co., Philadelphia, Pa., $8.40, $12.85, $21.25, $28, $592.15. Peet Valve Co. Boston, Mass.; $8.75, $13, $19.25, $28, $592.25. Galvin Brass & Iron Works, Detroit, Mich.; $8.25, $12.25, $20.90, $28.65, $592.45. Holly Manufacturing Co., Lockport, N. Y.; $8.75, $13.70, $22, $32, $650.10. National Tube Works Co., Mc Keesport, Pa., (Ludlow) $9.64, $15.55, $23.28, $32.24, $683.84. R. D. Wood & Co., Philadelphia, Pa.; (Eddy) $9.87, $16.15, $23.43, $32.99, $700.56. Chapman Valve Manufacturing Co., Indian Orchard, Mass.; $10.28, $15.81, $23.47, $35.73, $733.84. Walter Payne & Co., Fostoria, O.; $8.10, no bid, $19.75, $26.

Hydrants.—(*a*, without frost case; *b*, with frost case). Eddy Valve Co., Waterford, N. Y.; *b*, $24, total, $408. Peet Valve Co., Boston, Mass.; (Holyoke) *a*, $24.75; *b*, $27.83, $473,11. Galvin Brass & Iron Works, Detroit, Mich.; conical, *b*, $27, $459; straight, *a*, $25. $425; straight, *b*, $27, $459. Crane Bros. Manufacturing Co., Chicago: (Morgan) *b*, $25, $425. James Flower & Bros., Detroit, Mich.; *b*, $26, $442. Whittier Machine Co. Boston, Mass.; *b*, $26.40, $448.80. Chapman Valve Manufacturing Co., Indian Orchard, Mass.; *a*, $27, $459: *b*, $31.18, $530.06. I. S. Cassin & Co., Philadelphia, *b*, $28, $476. National Tube Works Co., McKeesport, Pa.; *b*, $28.92, $491.64. Holly Manufacturing Co., Lockport, N. Y.; *b*, $29, $493. R. D. Wood & Co., Philadelphia, Pa.; (Mathews)) *b*, $29.50, $501.50. Walter Payne & Co., Fostoria, O.; *b*, $35, $595.

Grading, Masonry and Sewer.—The following proposals have been received at the Department of Public Works, New York City: (1), Regulating, grading, curbing and flagging on 77th St.; James Slattery, $13,983.21; L. W. Johnson, $14,319.24; John Slattery, $16,620.32; M. J. Kane, $16,951; Thomas E. Crimmins, $18,427.18. (2), Similar work on 97th St.: John Brady, $3,468.95; John Cox & Co., $3,584.69; James Slattery, $4,871.36; Thomas E. Crimmins, $4,999.29; L. W. Johnson, $5,668.22. (3), Similar work on 138th St.; B. Mahon, $13,475.33; Leeson & Carr, $14,211.47; F. Thileman, Jr., $14,664.80; M. Fay, $15,744.58; W. F. Ewing, $16,352.05; John Slattery, $20,-485.02. (4), Retaining wall, stairway, etc., on 43rd St., John Cox & Co., $12,506; Dunn & Armstrong, $13,116.80; F. Thileman, Jr., $13,379.50; B. R. Guion, informal. (5), Sewer on Lexington avenue, $2,016.00; Geo. F. Masterson, $2,900; B. R. Guion, informal.

Proposals for Dredging Channel in Back Cove, Portland, Maine.

UNITED STATES ENGINEER OFFICE.
PORTLAND, MAINE, Feb. 18, 1887.

SEALED PROPOSALS in triplicate, for dredging in channel of Back Cove, Portland, Maine, will be received at this office, No. 537 Congress St., until 3 P. M. Friday, MAR. 11, 1887, and will be opened immediately thereafter in the presence of such bidders as may attend.

All necessary blank forms, and full information on the subject will be furnished to parties desiring to bid, on application at this office.

JARED A. SMITH.
8-3t Major of Engineers.

Ohio River Improvement. Machinery for Davis Island Dam.

U. S. Engineer Office, Cincinnati, Ohio.
January 31, 1887.

SEALED PROPOSALS in duplicate, will be received at this office until noon, local time, on Monday the 28th day of February, 1887, for furnishing and delivering at the Davis Island Dam, Ohio River, two pairs of Double Reversing Engines, either new or second-hand, with vertical boilers; each pair of engines with its accompanying boilers to rest on a single bed plate mounted on flanged iron trucks. One pair of engines to have cylinders 12 inches in diameter with 12 inch stroke, and the other pair to have cylinders 9 inches in diameter with 12 inch stroke.

Specifications and blank forms for proposals will be furnished on application to the undersigned.

WM. E. MERRILL,
8-2t Lieut. Col. of Engineers.

Proposals for an Iron Bridge.

U. S. ENGINEER OFFICE,
2,136 Pennsylvania Avenue, N. W.,
Washington, D. C., February 3, 1887.

SEALED PROPOSALS, in triplicate, will be received at this office, until 12 M., on Monday, March 7, 1887, for building an iron highway bridge, on the piers and abutments of the Aqueduct Bridge across the Potomac River, at Georgetown, D. C. The work will include the removal of the existing wooden superstructure and construction of additional masonry and embankment.

Specifications and all necessary information will be furnished on applicaton to

PETER C. HAINS,
7-4t. Lieut.-Col. of Engineers.

Proposals for Dikes in Mattaponi River.

UNITED STATES ENGINEER OFFICE,
No. 810 Nineteenth Street, N. W.,
Washington, D. C., February 10, 1887.

SEALED PROPOSALS, in triplicate, for the construction of Dikes in Mattaponi River, Virginia, will be received at this office until 12.15 P. M., on the 10th of March, 1887, and opened immediately thereafter.

Specifications containing detailed information and blank forms of proposals can be obtained at this office, where plans and drawings can also be seen.

The right to reject any or all proposals is reserved.

7-3t. S. T. ABERT, U. S. Agent.

Proposals for Dikes in Pamunky River.

UNITED STATES ENGINEER OFFICE,
No. 810 Nineteenth Street, N. W.,
Washington, D. C., February 10, 1887.

SEALED PROPOSALS, in triplicate, for the construction of Dikes in Pamunky River, Virginia, will be received at this office until 12 o'clock noon, on the 10th of March, 1887, and opened immediately thereafter.

Specifications containing detailed information and blank forms of proposals can be obtained at this office, where plans and drawings can also be seen.

The right to reject any or all proposals is reserved.

7-3t. S. T. ABERT, U. S. Agent.

Dredging in Connecticut River, Conn.

ENGINEER OFFICE, U. S. ARMY,
Room 57, Army Building,
Corner Houston and Greene streets,
New York, February 24, 1887.

SEALED PROPOSALS, in triplicate, for Dredging in the Connecticut river, below Hartford, Conn., will be received at this office until twelve (12) o'clock, M., on Saturday, March 26, 1887.

Further information, specifications, and forms of proposals can be obtained at this office.

D. C. HOUSTON,
9-4t. Lieut. Col. of Engineers.

IN the interval, 1850–1887, naval guns have increased in weight from 4½ tons to 110 tons; in powder charge, from 16 to 900 lbs.; weight of projectile, from 68 to 1,800 lbs. in energy of impact, from 450 ft. tons to 50,000 ft. tons at 1,000 yds. range. The 68-pounder failed to penetrate 4¼ in. of wrought-iron armor, while the 110-ton gun can pierce 35 in. of iron at 1,000 yds.